Montana Chapter of The Wildlife Society

56nd Annual Conference 2018

Telling Our Story - Lesson's Learned

February 19-23, 2018
Copper King Hotel & Conference Center
Butte, Montana

Kelvin Johnson, President Elect 2017-18
Montana Chapter of The Wildlife Society

Introduction

Our conference theme this year revolved around telling our story, as well as sharing our lessons learned. There are many success stories that have come to fruition large in part due to wildlife professionals effectively communicating our management experience and research knowledge with others. Conversely there are situations where our wildlife messages have been lost due to one reason or another. And in almost all cases, if we were to do it over, we'd choose to communicate something differently. Given the issues surrounding wildlife and wildlife conservation, it is becoming more important that we, collectively, are effective at communicating our wildlife knowledge and experiences with others. Whether we are bringing our information from the field to our managers or administrators, from agency to agency and other partners, to stakeholder groups, members of our public, or to our policy and law makers, we need to effectively tell our story.

Before the main conference began we had three workshops. One explored how to effectively promote and utilize conservation programs when working with private landowners; another provided a hands-on and in the field experience learning about one of the most powerful means to tell our story to the public through wildlife photography; and finally, an in-depth workshop was designed to help wildlife professionals find their voices when it comes to talking policy and conservation.

After the workshops, the conference began with a plenary session that focused on how wildlife conservation perspectives can be effectively communicated with others. To do this, we had 5 panelists that shared their experiences and ideas from their various perspectives, which included government agency administration, partnership coordination, popular journalism, stakeholder groups and law-making processes. By gaining additional insight into their perspectives, we aimed to better understand how effective communication can influence wildlife conservation within and beyond the boundaries of Montana.

We had 48 papers that were presented during concurrent sessions. There were 15 students presenting this year and we were fortunate enough to schedule their presentations so that no two students presented at the same time. There were 20 posters presented, with 10 of them presented by students.

At this year's banquet, our keynote speaker was Andrew Mckean, former editor-in-chief of Outdoor Life. He shared, from his perspective, how social science trends will change our jobs. The evening also included a tribute by John Weigand to one of the founding charter members of Montana TWS, Dr. Richard Mackie, who passed away January 6, 2018.

Plenary Session Abstracts

Welcome to Butte – 1984 Redux

Terry N. Lonner - A "Butte Rat" and Wildlife Research Biologist - Retired, MFWP

The last time the annual meeting of the Montana Chapter of the Wildlife Society's annual meeting was held in Butte was in 1984. At this meeting a "Welcome to Butte" presentation began by T. Lonner assisted by his wife, Martha, using two slide projectors, a dissolve unit and a "Boom Box" for audio. At this 2018 meeting a very similar introduction was presented, but this time a state-of-the-art digital audio/video system was used to present his introduction with a short movie celebrating the immigration of 12 million people to America through Ellis Island. For many of them Butte was their major destination. Butte developed from a silver and gold mining camp of a few hundred people in the 1860s and by 1919 became the largest city between Minneapolis and Seattle with a population of 100,000 including 38 nationalities and 20,000 mine workers. During Butte's mining heydays there were about 10,000 miles of shafts, tunnels, drifts and stopes underneath its surface and some of them were a mile deep. In 1917 Butte was producing almost 50% of the nation's copper and about 25% of the world's copper. Because of poor working conditions the miners eventually formed the Butte Miner's Union, one of the richest and strongest unions in the United States. The Berkeley Pit was started in 1955 and operated until 1982. After the underground mines were shut down in 1983 and the water pumps were turned off, the Berkeley Pit began filling with water until it reached a current depth of about 900 feet. It has become one of the largest bodies of toxic water in the world and is now the focus of our Nation's largest Superfund site with white geese using it to their detriment. Montana Resources resumed open pit mining in 1985 with the Continental Pit. In spite of all this mining activity and environmental degradation, the citizens of Butte have been and still are very involved with helping to conserve Montana's wildlife. The Butte Gun Club began in 1885 and in the early 1900s Butte sportsmen's clubs were organized like the Butte Anglers Club and the Rocky Mountain Sportsmen's club. They were instrumental in helping fund the first elk transplant in 1910 to the Mt Fleecer area southwest of Butte. Jim McLucas, a Butte native and WWII Marine Veteran, became Montana Fish and Game Department's first trapper in 1946. He supervised the trapping and transplanting of over 16,000 big game animals throughout Montana and the west including Hawaii. The sportsmen of Butte reorganized in 1957 and formed the Skyline Sportsmen's Association. They continue to remain vigilant in monitoring Montana's wildlife management and conservation issues and activities.

Tap 'er Light!

Agency Perspectives

Martha Williams, Director, Montana Fish, Wildlife & Parks, Helena

Abstract not available at press time.

Decreasing the Noise to Signal Ratio through Better Communication and Partnerships

Carolyn Sime, Sage Grouse Habitat Conservation Program Manager, Montana DNRC, Helena, MT

Science is embedded throughout our lives. We fight over how science is used or misused in public policy decision making. In particular, group decision-making on natural resource issues is hard wired for conflict. Individuals have different values and desired outcomes, yet a decision has to be made by some public policy making body on behalf of the whole. Science informs the decisions, but narratives and facts compete. Conflicts are often perpetuated when

narratives and facts are contradictory. This dynamic creates a very high noise to signal ratio for decision makers. Wildlife professionals can take a leadership role and increase their effectiveness by taking a more narrative approach to communicating scientific information to non-scientists rather than the way we are traditionally taught and communicate with each other. As natural resource challenges have become more complicated, collaboration and partnerships have become more integral to the finding durable solutions. Keys to successful partnerships include: a shared vision of desired outcomes; ownership in the outcomes; a common understanding of applicable science and facts; honest dialogue; and sustained commitments.

Catch and Release: How to Work with Journalists to Tell Your Wildlife Story

Brett French, Outdoor Editor, Billings Gazette, Billings, MT

Those odd subspecies of humans known as journalist can help wildlife biologists and agencies tell their unique story in a "hey Martha" way. But how do you deal with them? What do they want to know? And is it OK to dart one if they get out of hand? Veteran newspaper journalist Brett French will offer suggestions to help wildlife professionals catch a journalist's attention and release them to get your story across to the public or associates in a clear, concise and helpful manner. Montana residents care about what's happening with wildlife and wildlands. Communicating to that constituency in an interesting and visual way can help build trust, establish a rapport with the public and lead to support for initiatives or complex problem solving.

Building Relationships from the Ground Up

Jay Bodner, Natural Resources Director, Montana Stockgrowers Association, Helena, MT

Montana, like many states, has taken an active role to be more effective in managing wildlife. With private land comprising 67 percent of the state and 80 percent of the habitat needed for species on the endangered species list, landowners play a critical role in wildlife management. Private landowners recognize they can be a valuable asset to wildlife professionals. Landowners have the unique ability to share the knowledge gained from living and working on the land; they have a unique understanding of wildlife and the conditions that affect them. The key to an increase in management effectiveness is developing a working relationship with landowners and communication. When positive interpersonal relationships are developed, trust is built. This trust results in an increased exchange of quality information and successful outcomes.

Condensing the Science of Wildlife Management into Everyday Language

Nick Gevock, Conservation Director, Montana Wildlife Federation, Helena, MT

How do professional biologists effectively communicate to the public about wildlife? What do we as biologists do well, do poorly, and how can we improve? And what can we provide to wildlife conservation organizations to help them implement good wildlife policy? Wildlife biologists spend a lot of time talking to each other. But in order to convey wildlife science and management to the public, they need to learn how to condense the science of wildlife management into everyday language that hunters, anglers and wildlife enthusiasts understand. Those questions will be explored in this plenary session by Nick Gevock, conservation director for the Montana Wildlife Federation in Helena. MWF works during the Legislature and throughout the year to promote abundant wildlife and healthy habitat. Please join in this session to learn better ways to communicate our professional work.

Presentation Abstracts

In Order of Presenting Author
*** Denotes Presenter**
****indicates student presentation**

Surveillance Strategy for Detecting Pseudogymnoascus Destructans (PD) and White-Nose Syndrome in Montana 2016-2017

Emily Almberg*, Montana Fish Wildlife and Parks, Bozeman
Dan Bachen, Montana Natural Heritage Program, Helena
Lauri Hanauska-Brown, Montana Fish Wildlife and Parks, Helena

The devastating bat disease, White-Nose Syndrome (WNS), caused by the fungus *Pseudogymnoascus destructans* (*Pd*), was detected in western Washington state in March of 2016. This detection was 1,300 miles from the previous westernmost detection and highlighted the urgency for surveillance in other western states like Montana. Early detection of the disease may provide valuable insights into the statewide status of WNS, research opportunities, mitigation options and cave management. The goals of Montana's surveillance plan include 1) surveying for WNS/Pd in new geographic areas outside the WNS-affected zone and/or biologically important sites and 2) surveying for WNS infection in bat species that are not currently known to be susceptible. In the absence of information or a risk assessment to help Montana focus on priority surveillance areas other than winter hibernacula, the 2017 strategy focuses on sampling at six hibernacula representing all regions where aggregations of bats overwinter. Both active and passive sampling of bats and hibernacula environments will be conducted. Active sampling can detect Pd from swabs of bats or in hibernacula soils. Passive sampling will be conducted into the early summer specifically targeting bats found dead outside of hibernacula, bats showing clear signs of WNS infection, and bats found dead as part of a large mortality event. Bats submitted for rabies testing may also be sampled when circumstances or characteristics of the carcass indicate WNS may be the cause of mortality. While surveillance efforts can be costly it may provide information with enough time to better inform decision making.

Chronic Wasting Disease in Montana

Emily Almberg*, Montana Fish, Wildlife, and Parks, Bozeman
John Vore, Montana Fish, Wildlife, and Parks, Helena
Jennifer Ramsey, Montana Fish, Wildlife, and Parks, Bozeman
Zach Mills, Montana Fish, Wildlife, and Parks, Bozeman
Keri Carson, Montana Fish, Wildlife, and Parks, Bozeman
Justin Gude, Montana Fish, Wildlife, and Parks, Helena

In 2017, Montana Fish, Wildlife, and Parks (FWP) convened an internal working group and a Citizen's Advisory Panel to update the state's chronic wasting disease (CWD) surveillance and management response plans. As part of the plan, FWP initiated intensive CWD surveillance in deer and elk in southcentral Montana in the fall of 2017. Through this effort, we detected our first cases of CWD in wild mule deer and white-tailed deer south of Billings, Montana. We also happened to sample a hunter-harvested mule deer that was part of a mule deer movement study north of Chester, MT, near the Alberta border; this animal

turned out to be CWD-positive as well. Although disappointing, neither of these detections were surprising. We've known that CWD is likely to spread to these areas from infected populations in our neighboring states and provinces. With commission approval, FWP called special hunts in both areas to determine prevalence and distribution of CWD within the affected deer populations. Here we will report on the results from our general surveillance and special hunts and will discuss the options for future management of the disease.

**Analysis of Spiny Softshell Turtle Population Structures in Five River Systems in Eastern Montana

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Andrhea Massey, Rocky Mountain College, Billings, MT
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The spiny softshell turtle (*Apalone spinifera*) is designated as a species of concern in the state of Montana due to a lack of knowledge regarding their conservation status, loss of habitat connectivity and anthropogenic changes in hydrology. Information on population abundance and basic population structure for this species is necessary to understand how altered hydrological regimes and catastrophic events may affect this highly aquatic species. Spiny softshell turtles were studied in five river and creek systems in southeastern Montana. Over three years a total of 553 spiny softshell turtles were captured. The proportion of females to males captured across all five systems was not significantly different between creeks and rivers, with a total of 89.69% females and 10.31% males. We developed four length / age classes (juvenile, sub-adult, reproductive adult, mature adult) based on reported age cohorts from other studies. Numbers of spiny softshell turtles in each cohort were found to be significantly different between the five systems $p < 0.00001$. The Musselshell and Yellowstone Rivers and Pryor Creek had evidence of juvenile age classes and a more even distribution of age classes than the other systems. The Bighorn River had mostly larger adults and the Musselshell River lacked significant numbers of mature adults. Average seasonal water temperatures, timing and magnitude of spring pulse flows, ice cover and scour in winter, and abundance of open gravel bars, should be examined as possible factors which may explain the observed differences in spiny softshell turtle demographic structures on these five systems.

**Factors Influencing Migratory Behavior of Elk Across Montana

Kristin J. Barker*, Montana Cooperative Wildlife Research Unit, University of Montana, Missoula
Michael S. Mitchell, USGS Montana Cooperative Wildlife Research Unit, University of Montana, Missoula
Kelly M. Proffitt, Montana Fish, Wildlife and Parks, Bozeman

Increasing numbers of ungulates that remain resident on winter range year-round rather than migrating to higher-elevation summer range pose a common management challenge in western North America due to issues of property damage and reduced public hunting opportunities. Although the effect of forage on migratory behavior of ungulates is fairly well-understood, relative influences of other factors that may drive individual variation in migratory behaviors remain less clear. We are investigating how forage variability, conspecific density, animal age, and human land use affect the likelihood that an adult female elk (*Cervus canadensis*) will migrate or exhibit intermediate behavior rather than remain resident on winter range. We assessed behavior of 312 elk in 16 herds across southwestern Montana

using radiocollar data collected during 2006-2016. Approximately 64% (n = 200) of elk migrated, travelling up to 110 km from their winter locations. Preliminary results suggest migrants tended to be older than residents or intermediates (19% of migrants ≥10 yrs old vs. 6% and 4%, respectively; $p = 0.003$), to experience higher conspecific density during winter ($F_{2,309} = 12.19$, $P < 0.001$; p-adj. < 0.01 in both cases), and to be located in areas where forage varied more predictably across space and time ($F_{2,309} = 28.94$, $P < 0.001$; p-adj. < 0.001 in both cases). Identifying the factors that most strongly influence migratory behavior will help managers understand current patterns of behavior, predict how patterns may change in the future, and identify potential means of manipulating behaviors to meet management objectives.

The Search for Black Swifts: a Species of Concern, Inventory Need and Legend

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Chris Hammond*, Montana Fish, Wildlife and Parks, Kalispell
Amy Seaman*, Montana Audubon, Helena

Since 2004, when only three known nesting colonies had been identified in Montana, Black Swifts (*Cypseloides niger*) have been a state priority species for inventory and monitoring. They are an unusual neotropical migrant bird that initiates nesting in Montana when most other birds are completing their breeding seasons, with young not fledging until August or September. Black Swifts are reliant upon perennial streams, waterfalls, and insect prey for survival and are considered at high risk of extirpation, due to climate change. In 2015, Canadian biologists listed Black Swifts as endangered due to significant population declines. Since 2012, partnerships have coalesced around the search for this illusive and hard-to-detect bird, striving for standardized surveys that can shed light on the bird's presence and distribution in Montana. Over time, we have refined our protocol, training, and survey methods, and with these lessons learned, turned 2017 into one of our most successful survey seasons yet, more than doubling the known number of swift colonies in Montana. At the same time, however, we documented possible losses of colonies. As we continue with swift inventories, we are developing long-term monitoring plans, and exploring the use of new tools and models to help us better assess waterfalls for presence of Black Swifts.

**Lewis's Woodpecker Nest Success and Nest Site Selection in The Bitterroot Valley

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Kate R. Stone, MPG Ranch, Missoula, MT
Tom E. Martin, USGS Montana Cooperative Wildlife Research Unit, Univ. of Montana, Missoula

Identifying factors that drive habitat selection and how these factors influence reproductive success is important to species conservation, especially for promoting growth of populations in danger of extirpation. We studied Lewis's Woodpecker (*Melanerpes lewis*), a declining species in which information regarding reproductive success is limited. Lewis's Woodpeckers are found in high concentrations along cottonwood forests, yet prior research suggests they have low reproductive success in this habitat. We investigated the relationship between nest site selection and nest success by monitoring over 200 nests across two preferred habitat types: cottonwood floodplain forests, and burned coniferous forests. We also compared vegetation and local habitat characteristics to determine the drivers of nest site selection and their influence on nest success. Our results demonstrate that Lewis's Woodpeckers primarily

selected tall nest trees, and high density of large mature trees. They particularly avoided dense canopy cover in the floodplain, and high density of small snags in the burned forest habitat. Despite this, we found limited evidence that vegetation characteristics influenced nest success. Overall, nest success was best explained by habitat type and hatch date, with nest success being highest in burned forest habitat and in individuals that initiated nests earlier in the season. Our data improves our understanding of the relationship between habitat selection and reproductive success in a species of conservation concern, and will provide land managers with information on the drivers of nest success in this species, as well as other species that share similar ecological niches.

From Kishinena to POM: Montana's Wolf Recovery Story

Diane K. Boyd*, Montana Fish, Wildlife & Parks, Kalispell

Wolves were extirpated from 95% of their historical range in the lower 48 states by the 1930's. Montana's wolf recovery began in the 1970's through natural dispersal from Canada, monitored by students/staff from the University of Montana. The USFWS coordinated western recovery efforts, culminating in the reintroduction of wolves to central Idaho and Yellowstone National Park in 1995-97. In 2004 FWP's Wolf Management Plan was approved by USFWS and federal funding awarded to FWP to staff and monitor recovery efforts. Wolves were delisted in Montana in 2011. Reintroduced and naturally recolonizing wolf populations increased and expanded rapidly and merged into one metapopulation by 2007, connected to Canada's 10,000 wolves. Most importantly, monitoring and research efforts, technology, public attitudes toward wolves, and agency approaches have radically changed over time. The author was involved with wolf recovery from the first wolf, Kishinena, to the present tri-state (MT, ID, WY) population of 2000 wolves, and current development of a Patch Occupancy Model (POM) to estimate Montana's wolf population. Many misperceptions are circulating in the public and private sectors about wolf origins, behavior, impacts on big game populations, and management strategies. Discussion will incorporate forty years of sociopolitical, ecological, and technological changes that can be applied to enhance wolf management decisions.

Best Practices for Waterfowl Mitigation at the Berkeley Pit, Butte, Montana

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Janet Ellis, Montana Audubon, Helena, MT
Jay Selmer, Biological Science, Montana Tech

November 28, 2016, marked an unprecedented fall migration event: an estimated 60,000 Snow Geese (*Anser caerulescens*) and Ross's Geese (*Anser rossii*), often termed light geese as a combined flock, landed in the Berkeley Pit. Mine personnel successfully hazed most of these birds off the Pit; however, about 3000 geese died despite round-the-clock hazing efforts that continued for days. Until that time, the Berkeley Pit's records on preventing avian mortality showed a 99.8% success rate, including light geese. This success draws questions of why mortality rates were so high in 2016 and what could be done to improve practices. This research reports on the first year of an on-going investigation effort geared towards those questions. Findings address climate trends, biodiversity, and avian biology as they relate to the area. We examined historic climate trends and compared them to regional weather events

that led up to the November 2016 light goose event. We estimate 42 bird species may use the Berkeley Pit for seasonal/regional activity and are tracking site-specific preferences for this unique environment. Specifically, we surveyed waterfowl trends, and determined that identification of and information on the different species, combined with weather patterns, may enhance or detract from deterrent and hazing efforts. Collectively, our work provides a biological overview of the Berkeley Pit, the role it plays for waterfowl specifically during migration, and how this knowledge can be used to minimize the use of the Pit in the future use of and loss of waterfowl that land on Pit water.

Confessions from Sagebrush Rehab: Experiences Restoring Sagebrush in Central Montana

Matthew J. Comer*, BLM, Lewistown, Montana

Recent wildfires and the desire to reestablish Wyoming big sagebrush (*Artemisia tridentata* ssp. *Wyomingensis*) from local seed sources has had varying degrees of success in the Lewistown Field Office. Hand stripping sagebrush seeds adjacent to a 2010 wildfire and immediately broadcasting them in areas with high tree mortality exceeded expectations for sagebrush recruitment and growth. Early successes led to refining techniques to efficiently collect native seeds used to speed sagebrush reestablishment and store for future rehabilitation efforts in the event of a large scale disturbance. Sagebrush seeds were cleaned and grown out in partnership with Special K Ranch and Montana prisons, then planted in the fall using tree planters, gas powered augers and dibble bars. Depending on site conditions, the three planting methods could be considered and scaled to larger areas. Planting seedlings was most efficient in areas with low vegetative regrowth.

Grizzly Bear Recovery and Delisting: Progress Report

Hilary S Cooley*, USFWS Grizzly Bear Recovery Program, Missoula

The grizzly bear was listed as a threatened species in the lower 48 states in 1975. Accordingly, The U.S. Fish and Wildlife Service (Service) developed a Grizzly Bear Recovery Plan and updated that plan as necessary. The Greater Yellowstone Ecosystem was the first population to achieve recovery. On June 30, 2017, the Service issued a final rule delisting the Greater Yellowstone Ecosystem Distinct Population Segment. The Service is now reviewing recovery of grizzly bears in the Northern Continental Divide Ecosystem. We review progress toward grizzly bear recovery and delisting, including litigation challenges and future management once delisting has been achieved.

Potential Paths for Male-mediated Gene Flow between the NCDE and GYE Grizzly Bear Populations

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For decades, grizzly bear populations in the Greater Yellowstone Ecosystem (GYE) and the Northern Continental Divide Ecosystem (NCDE) have increased in numbers and range extent.

The GYE population remains isolated and although effective population size has increased since the early 1980s, genetic connectivity between these populations remains a long-term management goal. We delineated potential paths for male-mediated gene flow between the populations. We first developed step-selection functions to generate conductance layers using landscape features associated with non-stationary GPS locations of 124 male grizzly bears (199 bear-years). We then used a randomized shortest path (RSP) algorithm to estimate the average number of net passages for all grid cells in the study region, when moving from an origin to a destination node. Repeating this process for 100 pairs of random origin and destination nodes, we identified paths for three levels of random deviation from the least-cost path. We observed broad-scale concordance between model predictions for paths based on NCDE individual versus GYE individuals for all three levels of movement exploration. Models indicated that male grizzly bear movements could involve a variety of routes, and verified observations of grizzly bears outside occupied range supported this finding. Where landscape features concentrated paths into corridors, they typically followed neighboring mountain ranges, of which several could serve as pivotal stepping stones. The RSP layers provide detailed, spatially-explicit information for agencies and organizations to identify and prioritize conservation measures that maintain or enhance the integrity of areas conducive to male grizzly bear dispersal.

Moose Population Dynamics in Montana: Results From the Halfway Point of a 10-Year Study

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Jesse R. Newby, Montana Fish, Wildlife and Parks, Kalispell

Facing indication of moose (*Alces alces*) population declines in Montana and elsewhere in recent decades, Montana Fish, Wildlife & Parks began a 10-year study in 2013. We aimed to estimate population growth rates and vital rates, and to assess the relative influence of a suite of factors potentially limiting moose populations in 3 study areas. During 2013–2017 we captured and radio-collared 122 adult female moose, and annually monitored vital rates of adult survival, pregnancy, parturition, litter size, and calf survival associated with each collared female. Preliminary results from the first 4 biological years of monitoring are indicative of 3 different scenarios playing out across the 3 study areas. In the Cabinet-Fisher area of northwest Montana, relatively high adult female annual survival (0.93, SE=0.026) coupled with lower rates of fecundity (0.63 calves/female) and calf survival (0.31, SE=0.065) have yielded a stable to slightly increasing population growth rate estimate of $\lambda = 1.02$. In the upper Big Hole Valley of southwest Montana, somewhat lower adult survival (0.837, SE=0.036) coupled with higher rates of fecundity (0.71 calves/female) and calf survival (0.437, SE=0.063) translate to stable to slightly decreasing population growth rate estimate of $\lambda = 0.98$. Lastly, on the Rocky Mountain Front, high rates of all vital rates, including adult female survival (0.927, SE=0.027), fecundity (0.81 calves/female), and calf survival (0.507, SE=0.063) indicate an increasing population, with an estimated growth rate of $\lambda = 1.12$. We have not yet completed formal sensitivity analyses of vital rates or limiting factors, but results to date suggest meaningful roles being played by parasites, predators, and nutrition, each to varying degrees depending upon the study area.

Elk Forage and Risk Tradeoffs During the Fall Archery Season

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Justin Gude, Montana Fish, Wildlife and Parks, Helena

Elk (*Cervus canadensis*) need access to adequate nutrition during late summer and fall to support physiological requirements for reproduction and overwinter survival. Montana's fall archery hunting season can affect distributions of elk that may require animals to choose between accessing adequate forage and minimizing risk of harvest. We used radiocollar data from female elk in the Sapphire Mountains during late summer and fall to evaluate the extent of this potential tradeoff across a gradient of hunting risk. Our results indicated that during the archery season elk with higher-risk summer-fall ranges (i.e., those with higher proportions of hunter accessibility) selected more strongly for areas away from motorized routes than elk with lower-risk ranges. Elk distribution was most influenced by forage quality, however, and elk selected strongly for areas of high forage quality regardless of the level of risk, suggesting that elk in the sapphires do not compromise access to nutritional resources during the archery season. Elk with lower-risk summer-fall ranges had access to higher mean forage quality than elk with higher-risk ranges, possibly due to the availability of haystacks and pivot-irrigated areas on private lands. Managers interested in encouraging elk to remain on public lands during the hunting seasons may consider balancing hunting risk and forage resources across the landscape during the archery season. Strategies for public lands might include closures to motorized travel, limiting hunter pressure, and improving forage quality, and strategies for private lands might include working to enhance hunter accessibility and restrict elk access to high-quality forage resources.

Movements of Red-tailed Hawks Captured During Fall Migration in Western Montana

Robert Domenech*, Raptor View Research Institute, Missoula, MT
Adam Shreading, Raptor View Research Institute, Missoula, MT

We have studied the fall migration of raptors at the MPG Ranch, located in the northern Bitterroot Valley of western Montana since 2011. Our fall migration count annually records more Red-tailed Hawks (*Buteo jamaicenis*) than any of the five other raptor migration count sites in Montana. Banding efforts at our site have yielded modest totals, but impressive species diversity, with a relatively high proportion of Red-tailed Hawks. In 2015, we began a satellite telemetry study to specifically target fall migrating Red-tailed Hawk. We hope to identify migration routes, wintering and summering ranges and discover if our birds use stopover areas while on migration. We are also interested in learning about the seasonal movements of non-breeding aged Red-tailed Hawks. For this pilot project, we outfitted 12 Red-tailed Hawks (4 adults, 4 hatch-year), with 22g solar Argos/GPS transmitters. We will share basic movement demographics and anecdotal observations collected thus far.

What We Know About Weather, Climate, Plants, Wildlife and Fish

Phil Farnes*, Snowcap Hydrology, Bozeman, MT

Using data from NRCS SNOTEL (SNOw TELemetry) sites and NWS climate stations can help define climatic conditions at locations occupied by concerned species. Relationships between climate and different animal species, aquatic life, trees and forage that have been observed will be presented. Some of the variables used are snow water equivalent (SWE), temperature, precipitation, growing degree-days winter severity, fall green-up, soil moisture and temperature. Daily data is generally more useful than monthly or seasonal averages. Climate variability that has occurred over long time periods is also useful when observing changes in survival, migration, reproduction or other physical changes. There is generally a poor correlation between climatic variables at lower elevations and higher elevations. It is imperative that this relationship be understood when evaluating climatic effects on species that move from lower to higher elevations or from higher to lower elevations during different seasons. It is also important that valley climatic conditions are not used to define relationship of species that occupy higher elevations.

**Evaluating Sample Size to Estimate Genomic Relatedness in Bighorn Sheep Populations

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Genetic research may be a useful approach for understanding factors that could impact productivity and restoration of bighorn sheep herds. For example, genetic consequences of inbreeding in small populations can impact recruitment, and relative relatedness among herds can help inform translocation decisions. This empirical simulation study quantified genetic attributes of bighorn sheep populations with a range of different herd histories in Montana and Wyoming to investigate genomic relatedness within and between herds and to estimate an optimal sample size per population for evaluating genetic diversity and distance. Employing an Ovine array containing ~700,000 single nucleotide polymorphisms (SNPs) with approximately 24,000 markers that are informative for Rocky Mountain bighorn sheep, we conducted whole genome genotyping. We analyzed genetic material from 30 individuals from each of four different populations that we predicted would differ in genetic characteristics due to population dissimilarities that included origin (native/reintroduced), population size, bottleneck history, degree of connectivity, and augmentation history. The four populations provided samples across a spectrum of these herd attributes and included Fergus, Taylor-Hilgard, and Glacier National Park in Montana and the Beartooth Absaroka in Wyoming. We examine relatedness estimates within herds using two different metrics to evaluate the potential for links between genomics and herd demography. By evaluating our simulation results, we conclude that a sample size of 25 is adequate for assessing intra- and inter-population relatedness. We discuss the utility of genetic analyses for improving knowledge of bighorn sheep populations and potential implications for bighorn sheep management.

Grizzly Bear Recovery Planning: Requirements Under the Endangered Species Act

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There are many common misconceptions about Recovery Plan requirements under the Endangered Species Act (Act). The Act requires the U.S. Fish and Wildlife Service to develop and implement recovery plans for endangered and threatened species, unless it would not promote the conservation of the species. Recovery Plans are guidance documents that must include site-specific management actions; objective and measurable criteria; and an estimate of the time and cost required to implement the recovery plan. The Service frequently receives questions and comments from partner agencies and the public about the Grizzly Bear Recovery Plan. The first recovery plan for grizzly bears was published in 1982 and subsequently revised in 1993. There have been multiple ecosystem specific revisions and supplements to the 1993. One of these supplements was the development of habitat-based recovery criteria for the Greater Yellowstone Ecosystem (GYE), as required by a 1997 court settlement agreement. In addition, the demographic recovery criteria were updated for the GYE concurrently with the delisting of the GYE grizzly bear population in both 2007 and 2017. This presentation will address frequently asked recovery plan questions, such as: When does the Service have to update recovery plans? Are recovery plans litigable? Do all recovery criteria have to be met to remove a species from the list of endangered and threatened wildlife?

**Elk Calf Survival in the Upper Bitterroot Valley, Montana

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In 2011, researchers from Montana Fish, Wildlife and Parks and the University of Montana initiated the Bitterroot Elk Ecology Project to evaluate the factors driving changes in elk populations in the southern Bitterroot Valley of Montana. After three years of evaluating the bottom-up and top-down effects on survival and recruitment of area elk populations, the research team determined that increasing elk calf survival in the southern Bitterroot may have positive effects on area elk abundance and low recruitment. Furthermore, the research team identified mountain lions as a major source of elk calf mortality. Thus, in 2012, area wildlife managers increased the harvest of mountain lions in the study area to increase elk calf survival. To evaluate possible changes in calf survival several years after the mountain lion harvest effort, we are formally repeating the original calf survival study. We have been monitoring survival of elk calves via radio telemetry from 2016 to present (n = 248 calves over the 2 seasons) in the East Fork and West Fork watersheds of the Bitterroot River. We will present comparisons of current calf survival in the upper Bitterroot study area with previous estimates. We will also present the results of an evaluation of associations between calf survival and factors such as forage availability, predation risk, and individual characteristics of elk calves.

Montana Statewide Bighorn Sheep Research Project: A Progress Report

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The fourth year of the Montana Statewide Bighorn Research Project has been completed and we have met all of our objectives to date. We have completed two capture events in each of the eight study herds, sampling a total of 495 animals and radio collaring 222 adult ewes. Analysis of the pathogen data has provided minimum sampling recommendations for determining what pathogens are present in a herd and have demonstrated that the pathogens associated with pneumonia are resident in most herds sampled. The first deployment of GPS store-on-board collars have been recovered from 7 of the 8 herds and have revealed divergent seasonal movement strategies among study herds with habitat modeling analyses currently underway. Pilot genomics studies have been completed providing guidance on the number of genetic samples required to adequately assess genetic attributes of herds, with preliminary results suggesting notable differences among herds. We have employed new analytical tools to economically identify and quantify a suite of 81 metabolites from a small serum sample from each bighorn captured. We are currently in the process of evaluating the resulting data in an attempt to develop a 'health panel' that can inform managers of the physiological and nutritional condition of animals that should reflect habitat conditions and resources available on each herd range. Adequate data have been collected to estimate adult ewe pregnancy and survival rates and, with management monitoring data on annual recruitment, will provide the data required to develop integrated population models.

Understanding Montana Landowners' Values, Attitudes & Behaviors towards Wildlife & Wildlife Habitat

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The Plains & Prairie Potholes Landscape Conservation Cooperative (PPP-LCC) identified habitat loss as a key research need in 2012. This grassland-wetland ecosystem provides essential habitat for an array of wildlife, especially waterfowl. Many factors contribute to loss of wildlife habitat, but ultimately it comes down to decisions made by the private landowner. Montana was part of a five state study (IA, MN, SD, ND & MT) of landowners in the PPP-LCC. Each state wildlife agency developed their questionnaire based on their agency's needs for information about landowners. Montana's specific objectives were to: (a) measure characteristics, attitudes, values and behaviors towards participating in a variety of conservation programs, and (b) identify meaningful segments of Montana landowners

for understanding conservation behaviors. The Montana landowner survey received 438 usable returns for a 32% response rate. We analyzed landowners based on four segmentation models: (1) Landowner Occupation Model (farmer, rancher, farmer/rancher, and non-ag), (2) Owning Lands Model, which was based on reasons for owning land in Montana, has four types based on how each group scored on three scales (personal use, conserve/protect habitat, and economics/income), (3) Wildlife Habitat Model has three types (low, medium, and high) based on the level of positive support for wildlife and wildlife habitat on private land and (4) Wildlife Value Orientations Model, based on how people feel about wildlife, has four types (Utilitarian, Mutualist, Pluralist, and Distanced). Each model is evaluated based on predicting behavior and other characteristics of the various sub-groups.

Common Loon Conservation and Management: A Success Story That Began 35 Years Ago

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The first comprehensive work on the common loon (*Gavia immer*) in Montana began in 1982 when Don Skaar initiated surveys across the breeding distribution in the northwestern part of the state. Eight years later, he completed the first management plan that identified 62 lakes with territorial pairs. Based on recommendations in the plan, research evaluating the effects of increased recreational use and development on common loon nesting was initiated. This group of individuals would go on to create the nonprofit organization that would become the seed for future growth in common loon conservation, the Montana Loon Society. The Common Loon Working Group was formed some years later to guide professionals in the conservation, management, and research on common loons in the state. I will discuss the history of common loon conservation in Montana and summarize research from the Montana Loon Study in the early 1990s and the Loon Ecology Project (2002-2008). I will share our successes and what I believe to be potential failures, as well as, what we may expect to see in the future.

Wolverines in Winter: Indirect habitat loss and functional responses to backcountry winter recreation

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Outdoor recreation is increasingly recognized to impact wildlife yet few studies have looked at recreation within large natural landscapes that are critical habitat to some of our most rare and potentially disturbance-sensitive species. Over 6 winters (2010 – 2015) and four study areas (>1.1 million ha) in Idaho, western Wyoming and southwestern Montana, we radio-collared 24 individual wolverines and acquired >54,000 Global Position System (GPS) locations over 39 animal-years. Simultaneously, we monitored winter recreation, collecting ~6,000 GPS tracks from backcountry winter recreationists representing ~200,000km of recreation activity. We combined the recreation GPS tracks with trail use counts and aerial-

based recreation surveys to map the extent and relative intensity of motorized and non-motorized recreation. We modeled habitat selection of male and female wolverines within their home ranges using resource selection models and functional responses. We found some differences in habitat selection between the sexes, including the females selecting colder, snowier areas possibly associated with denning. We then estimated the habitat selection responses of wolverines to backcountry winter recreation, assessed the potential for indirect habitat loss from winter recreation and tested for functional responses of wolverines to differing levels and types of recreation. Motorized recreation occurred at higher intensity across a larger footprint than non-motorized recreation in most wolverine home ranges. Wolverines avoided areas of off-road motorized and non-motorized recreation and females experienced higher indirect habitat loss than males. Wolverines showed negative functional responses to the level of recreation exposure, with increasing avoidance as levels of the recreation increase within the home range.

**Assessment of Bridges in Eastern Montana to Identify Active Season Bat Roosts

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Bats fulfill important niches in the ecosystems they occupy and control insect populations that are agricultural pests. Bat species across North America face several significant threats including habitat degradation/roost disturbance, wind turbine-related deaths, and White-Nose Syndrome (WNS). In Montana, bat roost information has been lacking in the nine eastern counties where Northern Myotis (*Myotis septentrionalis*) is listed as Threatened, as well as a large number of additional central and eastern Montana counties. To identify active season roosts across these regions, we surveyed bridges for bat use. From the surveys, we established baseline knowledge about bat roosting preferences and the locations of active roost sites to monitor, which can be used to better inform conservation efforts. Survey data were collected from bridges in nine counties in Eastern Montana, as well as from bridges in eight counties in central Montana. Bridges surveyed were classified by roost type (day, night, maternity, none). Structural materials, surrounding habitat characteristics, and other attributes were recorded. Night roosts were the most common roost type, concrete bridges were the most used bridge type, and maternity roosts were only found in wooden bridges with ideal crevices. Results which show widespread use of concrete bridges as roosts, and the importance of ideal crevices for day and maternity roosting bats, are consistent with previous studies in western and central Montana. Ideal crevices are an important structural characteristic for bridge roosting bats, which, when implemented in bridge design, provide suitable habitat in the face of increasing urbanization and human disturbance.

Establishing a Contemporary Baseline of Wolverine Distribution and Genetics Across Four Western States

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Wolverines (*Gulo gulo*) were extirpated from their historical range in the conterminous U.S. by about 1920. Since that time, some recovery has occurred, but the extent of their distribution has remained undefined due to their naturally low densities and use of rugged, remote terrain. Conservation of this metapopulation would benefit from initiation of a population monitoring program along with an understanding of the extent of current distribution, gaps in distribution, genetics and connectivity. We established a camera/DNA survey across current range states to obtain baseline information on occupancy and genetics of wolverines. During winters 2015–16 and 2016–17, we sampled 185 of 633 grid cells (15x15 km) that were >50% wolverine habitat. We detected wolverines at 59 of 185 cells. Citizen volunteers detected wolverines in an additional 35 cells. Probability of a wolverine being detected at least once at a site that was occupied was high (p=0.92) and did not differ between sites that were visited a single time vs. multiple times. Average estimated probability of wolverine occupancy during our study was 0.42 (95% CI 0.29–0.55). We detected more females than males. Spatial models indicated wolverine occupancy varied across the region, with highest probability in the Northern Continental Divide Ecosystem and lower on the southern and eastern periphery of the study area. Our regional occupancy estimates provide a baseline for future evaluations of change in wolverine distribution and occupancy through time, including the possibility of detecting influences on distribution due to climate, human influences, or continued range expansion.

**Estimating Recruitment of Wolves with Limited Data

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Successfully managing a species can require information on demographics. Recruitment is particularly important for harvested species because it determines the level of harvest that can be sustained by the population; thus, this information can be used to improve harvest decisions. When management occurs across large spatial scales, however, these data can be costly to collect and are often unavailable. Management of gray wolves (*Canis lupus*) in Montana could benefit from information about variation in recruitment. Existing data are insufficient for traditional methods to estimate recruitment, therefore a new approach is needed. Our objectives were to develop a method to estimate recruitment using available data and determine the amount of data needed to produce reliable estimates. Integrated population models can be a useful tool for demographic analyses from limited data sets. We developed an integrated population model to use collar, hunter survey, and group count data

to estimate recruitment of wolves. This method did not require collecting additional data and used available data from ongoing monitoring. We tested the model on a simulated data set to determine model sensitivity to the amount of data used. We found that the model estimated the true parameter values from the simulated data accurately with at least 12-25 group counts and approximately 10 collars per year. Ultimately, we will use this method to evaluate the spatial and temporal variation in recruitment across the state. This method can help reduce costs associated with monitoring wolf populations while providing valuable information needed to help inform management decisions.

Acoustic Monitoring of Avian Nocturnal Migration in the Bitterroot Valley, Montana

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Millions of birds migrate at night that emit sounds we can record and identify to species. In 2012, we began to record nocturnal flight calls of migratory birds at three monitoring sites. By the summer of 2017, we had expanded to over 25 sites throughout the Bitterroot Valley, ranging from valley-bottom high schools to ridge-top fire lookouts. We have collected and processed terabytes of recordings from spring and fall migration using customized, open-source software. Our archive now includes thousands of detections of passerines, the majority of which are calls from sparrows, warblers, and thrushes. In this presentation, we will share some of the migration patterns we have documented, the influence weather and other variables can have on migration, and how these data can contribute to our knowledge and conservation of bird populations. A longer-term goal of this project is to develop a network of acoustic monitoring stations across Montana, building a collaboration between private individuals, non-profits, and managing agencies. We will provide information on how you can participate in this project and attend a training workshop taking place this spring.

Better Understanding Montanans Thoughts Regarding Wolves and Wolf Management in Montana

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Following the 2016-17 wolf hunting/trapping seasons, Montana Fish, Wildlife & Parks (FWP) conducted four separate surveys of resident Montanans to better understand their views regarding wolves and wolf management in Montana. This research builds upon previous work of the agency to survey state residents in 2012. Survey finding revealed that tolerance for wolves on the Montana landscape remains relatively low. However, comparing the 2017 survey data to identical data collected in 2012 shows a slight shift in the direction of more tolerance for wolves over time, particularly among Montana households. Results also showed continued tolerance for wolf hunting in Montana across all four survey groups. In contrast, tolerance of wolf trapping varied substantially. While hunters and landowners were very tolerant of wolf trapping, nearly half of the respondents to the Montana household survey

were not tolerant of wolf trapping in the state. Lastly, for each of the four survey groups there was little agreement among respondents regarding whether the regulations for the Montana wolf hunting and trapping seasons were satisfactory or not. These survey results speak to the contentious nature of wolf management in Montana, and the importance of continue efforts on the part of FWP to involve the public in wolf management decisions and season setting processes.

Using the Scavenging Rate of Native Birds and Bats to Adjust Wind Farm Fatality Estimates

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Wind Farms have the potential to negatively affect bird and bat populations due to collisions with turbines. To estimate bird and bat fatality, the number of carcasses found beneath turbines is commonly corrected for removal by scavengers, which is quantified by measuring persistence of experimental carcasses. Often these studies use domestic animals as surrogates because fresh carcasses of wild animals (e.g., raptors and bats) are difficult to obtain. We present results from carcass persistence studies conducted at two sites and discuss observed differences between native and surrogate carcass types. Next, we ran simulations with the Huso Estimator using carcass persistence data from both surrogates and native animals to explore sensitivities on overall fatality estimations. Based on the results from field trials and simulations, carcass type may affect overall fatality estimates and therefore project management decisions.

Montana Biological Check Stations: A Time-Honored Tradition

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For nearly a century, Montana game check stations have been utilized to help monitor local or regional game harvest, collect biological data for management or research needs, monitor hunter activity, help disseminate information and/or answer questions and enforce hunting rules and regulations. This information is important in the ongoing design of game management programs, which provide for optimum game populations and sustainable hunting opportunity. This importance was emphasized with a state law passed in 1973 making it mandatory for hunters to stop at check stations on their routes to and from hunting. Currently, Montana Fish, Wildlife & Parks (FWP) operates at least 39 biological check stations in various ways throughout Montana. Despite its rural location in west central Montana, the Augusta check station, in operation since at least 1932, provides one unique perspective relative to the value of biological check stations. Open 7 days a week, 16 hours/day during the general fall big game rifle season, it is estimated that well over 200,000 hunters have traveled through this check station with just under 32,000 big game animals currently recognized in the database. Using data from the Augusta check station, information such as correlations to FWP hunter harvest survey estimates, deer and elk age estimates associated with game harvest weights, antler measurement data, public vs private land harvest location information and other hunter demographic information will be presented. Check stations are clearly an important tool in helping maintain Montana's game populations for the current and future hunting publics and are an excellent example of wildlife conservation and management in Montana through cooperation between hunters and FWP.

**Niche Similarities Among Introduced and Native Mountain Ungulates

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When two ecologically similar species are sympatric, theory predicts they will occupy distinct ecological niches to reduce competition. We evaluated the niche partitioning hypothesis with sympatric mountain ungulates – native bighorn sheep (BHS; Ovis canadensis) and introduced mountain goats (MTG; *Oreamnos americanus*) in the northeast Greater Yellowstone Area. We characterized seasonal niches using two-stage resource selection functions with a used-available design and descriptive summaries of the niche attributes associated with used GPS locations. We evaluated seasonal similarity in niche space according to confidence interval overlap of model coefficients and similarity in geographic space by comparing model predicted values with Schoener's D metric. Our sample contained 37,962 summer locations from 53 individuals (BHS = 31, MTG = 22), and 79,984 winter locations from 57 individuals (BHS = 35, MTG = 22). Slope was the most influential niche component for both species and seasons, and showed the strongest evidence of niche partitioning. Bighorn sheep occurred on steeper slopes than mountain goats in summer and mountain goats occurred on steeper slopes in winter. The pattern of differential selection among species was less prevalent for the remaining covariates, indicating strong similarity in niche space. Model predictions in geographic space showed broad seasonal similarity (summer D = 0.88, winter D = 0.87), as did niche characterizations from used GPS locations. Our results suggest that reducing densities of mountain goats in hunted areas where they are sympatric with bighorn sheep and impeding their expansion may reduce the possibility of competition and disease transfer.

Use of Talus and other Rock Outcrops by Bats in Western Montana

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Identifying roosts used by bats in natural features can be difficult, particularly in areas without known caves. Data on roosts is critical for monitoring populations to assess impacts of exotic emerging pathogens like *Pseudogymnoascus destructans*, which causes White-nose Syndrome, and to conserve important habitat for this taxa. Prior to our work, only 61 active season roosts were known in Montana. To determine if bats in western Montana are using talus/rock outcrops as a form of roosting sites, we completed 23 surveys of rock outcrops from mid-June to mid-July focusing on three regions of western Montana. We used three survey methods to assess bat presence: 1) acoustic detector/recorders, 2) visual encounter surveys (VES), and 3) mist net surveys in proximity to outcrops. Ten individuals were found during VES, most commonly *Myotis evotis/thysanodes*. Additionally, we used guano as an indicator of bat use and identified 35 roosts during searches. We completed 22 nights of mist netting and captured 36 individuals representing nine species associated with these outcrops. The most common capture was M. *yumanensis/lucifugus*, and all individuals were adults and

predominately male. Whether talus slopes that serve as active season roosts are also suitable for hibernation remains undetermined, but acoustic data from other locations supports this conclusion. Acoustic detectors placed in rugged landscapes record more winter activity than those in less rugged areas with presumably fewer outcrops. Future work is necessary to assess activity at rock outcrops across the year and identify the community of species that may hibernate within these features.

**Effects of Rangeland Management on Sharp-Tailed Grouse Habitat Selection in Mixed-Grass Prairies

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Temperate grasslands, including mixed-grass prairies, suffer from the greatest levels of habitat loss and degradation of any North American ecosystem. Grazing is the predominant land use on grasslands across western North America and directly affects the structure, composition, and productivity of these ecosystems. Rest-rotation grazing, which includes a year-long period of deferment, is implemented on conservation easements in Montana to improve wildlife habitat. However, this grazing system was developed in arid bunchgrass rangelands and its effectiveness has not been studied in more mesic mixed-grass prairie. Sharp-tailed grouse (*Tympanuchus phasianellus*) have large home ranges and require a wide range of habitat types for nesting and over-wintering, making them an ideal indicator species for grassland habitats. Rest-rotation grazing systems could influence grouse habitat selection at multiple spatial scales by providing patches of habitat that are periodically rested from disturbance. We investigated both home range selection in relation to the larger study area and selection of habitat features within the home range. We monitored 82 female sharp-tailed grouse in eastern Montana during the breeding seasons of 2016–17. Average home range size was 503 ± 56 ha. Grazing system was not a good predictor of home range size or space use within the home range. Grouse selected for intact areas of grassland when choosing a home range but we did not detect third-order habitat selection within home ranges for the population. The high level of individual variation in third order habitat selection suggests an apparent plasticity in resource use at fine spatial scales.

**Evaluating Long-term Turnover of Northern Goshawks within the Minidoka Ranger District of the Sawtooth National Forest

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The Northern Goshawk is listed as a management indicator species for the Minidoka Ranger District of the Sawtooth National Forest. This distinction has enhanced research interest on goshawk population health in the region. For raptors, annual adult turnover is considered a crucial metric of population health; providing insights into mortality, fidelity, and population disturbances. Over the past 25 years of studying goshawks, the Intermountain Bird Observatory (IBO) has observed abnormally high female turnover as compared to other places the species has been studied. Their estimations are based on banding and resighting birds, and

may be biased high due to undetected marked birds and unknown age of birds when banded. To increase accuracy of IBO's turnover data, we conducted parentage analyses using blood samples collected from goshawks in 2012-2016. We analyzed 32 samples from nine nest territories by examining shared alleles between adults and nestlings. With this analysis, we identified previously unknown turnover and fidelity events, increased known ages of banded birds, and quantified and removed bias from IBO's turnover estimations. Our work indicated that band-resight alone may be insufficient to produce accurate turnover estimates, and the inclusion of genetic analyses may mitigate inaccuracies. In addition, our results fundamentally altered IBO's understanding of goshawk population dynamics within the forest.

Conventional Oil Infrastructure Leads to Lower Abundances of Baird's Sparrow and Sprague's Pipit

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Although grassland songbird populations have steadily declined, little research has examined the effect of oil infrastructure on abundances of grassland songbirds. Even less research has identified mechanisms that explain observed effects. To evaluate this, we sampled abundance of 5 songbird species at oil well sites with different pump mechanisms, power sources, and activity levels; we also evaluated the effects of perch and road density and exotic vegetation, all of which are associated with oil development. We conducted 800-m abundance transects at 42 sites twice per year in 2013 and 2014 in Alberta, Canada. Our results showed both Baird's sparrows (*Ammodramus bairdii*) and Sprague's pipits (*Anthus spragueii*) had lower abundances at all sites that contained oil infrastructure. The other 3 species, chestnut-collared longspurs (*Calcarius ornatus*), western meadowlarks (*Sturnella neglecta*), and Savannah sparrows (*Passerculus sandwichensis*), were relatively unaffected by oil wells, linear features, or exotic vegetation. Our research suggests that mitigation must focus on minimizing the extent of above-ground infrastructure as a reduction of human activity and noise caused little change in the effects of wells on grassland songbirds. For publication, see Nenninger and Koper (2018), "Effects of conventional oil wells on grassland songbird abundance are caused by presence of infrastructure, not noise," Biological Conservation.

Estimating the Density of Large Carnivores: Evaluation of Sampling Designs and Integrated Data Sources

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Understanding the variation in the abundance of animals is critical for informed management of species. Large carnivores pose a particular challenge for the estimation of population size, given their large home ranges, elusive natures, and low densities. These characteristics render traditional approaches problematic. However, methodological advances in spatial capture-recapture models that explicitly incorporate spatial information into capture probabilities have allowed for improved estimation of abundance for such animals. Yet, little information exists regarding how to best allocate resources to sampling to optimize estimation. Although recent work has suggested that additional information, e.g. hunter

harvest and telemetry data, can yield improved inference and higher precision, it is unclear how to best integrate these multiple sources of data. This is particularly true for spatially unstructured sampling designs in which captures are the result of active searching, rather than arising from fixed sampling locations such as camera traps. We conducted a simulation-based power analysis of a spatially unstructured capture-recapture study design, and identified an optimal balance of search effort and radio-collar deployments. Under the best sampling plans, abundance estimates were only slightly biased even when effort was correlated with animal densities. However, we also found that abundance estimates were strongly affected when hunter harvest information was ignored or treated as part of the sampling design, rather than modeled using a separate detection process. Finally, we demonstrated the utility of these methods by estimating the space-use patterns and density of mountain lions in western Montana.

**Can Targeted Cattle Grazing Increase Abundance of Forbs or Arthropods in Sage-Grouse Brood-Rearing Habitat?

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Suboptimal brood-rearing habitat often limits sage-grouse (*Centrocercus urophasianus*) populations in western North America. In mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*) brood-rearing habitat, dense sagebrush canopy cover (> 25% cover) may limit the understory forbs and arthropods that sage-grouse prefer to eat during summer. We investigated whether protein supplementation could concentrate cattle browsing or trampling to reduce mountain big sagebrush canopy cover and increase the abundance of forbs or arthropods. We applied targeted cattle grazing within two large, contiguous pastures (650 ha each) in the Beaverhead Mountains of southwestern Montana. Pastures were grazed simultaneously at a light stocking rate (6.25 ha/AUM) for two weeks in mid-October 2015 and 2016. Vegetation and arthropod response was measured during the following June (2016 and 2017, respectively). Each year we evaluated vegetation and arthropod response within 16 sites where mountain big sagebrush canopy cover exceeded 30% pre-treatment. Sites were 0.008 ha to match the spatial scale at which sage-grouse broods select fine-scale habitat. In the first summer after treatment, supplemented sites averaged 78% less sagebrush canopy cover (8% vs 36%; $P < 0.001$) and 25% more forb canopy cover (15% vs 12%; $P = 0.122$). Forbs also comprised a greater proportion of the herbaceous understory in the supplemented vs. non-supplemented sites (48% vs. 36%; $P = 0.002$). Abundance of sage-grouse arthropods (i.e., arthropods from families documented in the literature to be eaten by sage-grouse) did not differ between supplemented and non-supplemented sites ($P = 0.796$).Sagebrush cover was reduced by cattle trampling, not browsing.

Bobcat Population Reconstruction and Harvest Management

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We backdated ages of 31,257 bobcats (*Lynx rufus*) to estimate populations in each of 7 Montana trapping districts (TDs) for the years 2000-2016. To account for effects of variable effort on harvest and population estimates we established harvest scalars for each TD based on harvester effort. In all but TD 6, bobcat populations peaked in 2005, 2006 or 2007. In western Montana, TDs 1-3, adult populations were 6.8% above to 11.4% below average in 2012 and were predicted to increase to near or above average between 2012 and 2017. Adult populations in eastern Montana, TDs 4-7, were 22.3%-37.4% below average in 2012 and predicted to increase between 2012 and 2017 although remaining well below average. Lambda for adults was very low in all TDs in 2009 but improved to above or near 1.0 in most years and TDs in western Montana after 2009. In eastern Montana, lambda remained below 1.0 in most years and TDs after 2009. The number of bobcats trapped per day in year t was the best predictor of adult populations in year t+1 and number of juveniles per adult captured in year t was the best predictor of adult growth rate in t+1. Using observed relationships between total harvest and lambda of total populations we estimated a harvest level for each TD that historically was correlated with stable or increasing populations. Using predictions for population and lambda along with historic population trends managers will have information to more accurately set annual quotas.

**Habitat Conditions Associated with Colonization of Suboptimal Habitats by Beavers in Southwest Montana

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Awareness of beavers as integral components of healthy ecosystems has increased in recent decades, and as a result beaver-mediated habitat restoration projects are becoming more common. Beaver restoration sites are frequently located in degraded stream systems with little or no beaver activity. However, the selection of restoration sites is often based on habitat suitability research comparing well-established beaver colonies to unoccupied stream sections. This approach may over-emphasize habitat conditions that are modified by beaver activity. We conducted beaver-use surveys on streams in the upper Gallatin and Madison River drainages to investigate habitat selection by beavers starting new colonies in areas where most optimal beaver habitat is occupied. We identified new colony locations in relatively unmodified stream segments and compared them to unsettled sites to evaluate baseline conditions that promote colonization. Beavers selected areas with low gradients, high canopy cover of woody riparian vegetation, and wetland types corresponding with willow cover and low-lying areas directly adjacent to the stream channel. However, the effects of these habitat components on the probability of settlement were weak and colonization patterns were highly variable. Models developed based on well-established beaver colonies in the study area supported different interpretations of habitat selection patterns. This gives credence to the hypothesis that habitat selection studies based on active colony locations may not provide reliable information on settlement site selection by beavers starting new colonies in novel areas. Our research provides recommendations for beaver restoration practitioners to select restoration sites that will have the highest probability of successful colony establishment.

More than Fish – Incorporating Riparian and Wetland Dependent Bird and Herptile Habitat into Stream Restoration Projects in Western Montana

Rob Roberts*, Trout Unlimited, Missoula, MT

Millions of dollars are spent annually on watershed restoration and habitat improvement in the Pacific Northwest to increase fish populations. In the last 20 years, Trout Unlimited (TU) alone has partnered on $7.5 million in projects that reconstruct or improve instream, riparian, floodplain and wetland habitats. Even though more than 50% of bird species in Montana breed in riparian habitats and 16 native amphibians, 3 turtles, and 7 of Montana's snakes find essential habitat in riparian areas, TU's stream restoration work has largely been done without considering the impacts or – more importantly - the potential benefits to riparian and wetland dependent birds and herptiles. Stream restoration often involves the physical manipulation of large landscapes, with precisely engineered design plans that define stream widths and depths, earthwork grading, soil/sediment size distribution and quality, and many other factors. Working with state and federal non-game biologists, conservation groups and other resource managers, TU has begun to focus on the structural considerations of stream restoration for birds, amphibians and reptiles in projects that have primary objectives for fisheries. Our intention is to translate published research on wildlife habitat and known habitat needs for breeding, foraging, and over-wintering for native herptiles and birds into design typicals and construction plans. TU will present lessons learned from these emerging conversations and preliminary results from stream restoration activities in Ninemile Creek and other projects in western Montana.

**Responses of Songbird Populations and Breeding to Cattle Grazing Regimes in Sagebrush-Steppe of Montana

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Lorelle I. Berkeley, Montana Fish, Wildlife, and Parks, Helena
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A large portion of sagebrush-steppe across the west is used for grazing of domestic livestock, primarily cattle. We compared songbird communities over five breeding seasons in central Montana between two grazing systems: a system using a combination of rest and deferment (hereafter rest-rotation) and traditional grazing. For the purposes of our study, we define rest-rotation grazing as changing the timing of grazing in pastures each year, with some pastures alternately rested every few years. Traditional grazing is defined as grazing a pasture at the same annual season each year or all season. Recently, rest-rotation systems have been used as a conservation management tool by the Natural Resource Conservation Service's (NRCS) Sage Grouse Initiative (SGI). Their goal is to encourage private landowners to graze their livestock more sustainably in order to maintain or improve habitat for greater sage-grouse (*Centrocercus urophasianus*), as well as to improve rangeland productivity. We explore the effects of rest-rotation compared to traditional grazing on songbird population breeding demographics: adult abundance, nest density, and nest success. Abundance estimates are often used to assess conservation actions given the relative ease in collecting data to inform these estimates. However, information on how conservation actions influence life histories such as nest density and nest success are lacking, despite the fact that life histories inform abundance. Our goal is to understand the relationship between adult abundance, nest density, and nest success, and how land management practices, such as grazing, influence those patterns.

To SNIP or not to SNIP: Can We Improve our Understanding of Garter Snake Genetics?

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Stephen Spear, The Wilds, Cumberland OH

In the past we utilized microsatellite analysis to understand the genetic diversity of both Wandering Garters and Common Garters across Western Montana. The results showed no isolation by distance for both species. Perhaps after a period of rapid colonization, garter snakes experienced extensive inbreeding and/or assortative mating at localized sites. Alternatively, the initial colonists may have lacked genetic diversity. Making such broad claims from our findings is difficult because the number of alleles per locus for both species was low. This is a persistent problem for snake researchers throughout the research literature. We can't be sure if microsatellite analysis is itself problematic when studying these animals. SNIPs should help elucidate this problem and may help us begin to understand the phenotypic variability of garter snake populations across the region. In 2017 we expanded sampling of both species across the breadth of Western Montana. Unfortunately, the prolonged fire season lowered ground temperatures and made some populations difficult to access. I sampled 55 Common Garters and 185 Wandering Garters during the 2017 season. Because the total number of Wandering Garter samples (N=372) was much higher than Common Garters (N=160), we decided to first genotype the Wandering Garters and compare that to the results from the earlier microsatellite analysis. I will present the findings from this endeavor while also highlighting what I learned from observations of both species during the field season.

Migratory Bat Roost Use in the Bitterroot Valley

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Philip Ramsey, MPG Ranch, Missoula, MT

The roost-site use and migratory habits of silver-haired bats (*Lasionycteris noctivagans*) and hoary bats (*Lasiurus cinereus*) are poorly understood. This study provided some of the first documented roost locations and roost descriptions for silver-haired bats in Montana, and provided one of the first known efforts to attempt to characterize inter-annual site fidelity for these species. We used radio telemetry to track 34 silver-haired bats and 4 hoary bats to their day roost locations in 2016 and 2017. These tracking efforts resulted in discovery of 29 silver-haired bat roosts, which included a maternity colony of 43 individuals. No hoary bat roosts were documented despite extensive ground and aerial searches. Most silver-haired bat roosts (97%) were located within natural cavities of black cottonwood trees (*Populus trichocarpa*); however, roost trees did not differ in diameter, height, or decay stage compared to available trees. Based on radio telemetry information, hoary bats migrate through the study area in July and August, and silver-haired bats appear to migrate out of the study area in late August and early September. In addition to radio telemetry, we also marked individuals with PIT tags and recaptured 2 silver-haired bats in 2017 that were marked in 2016, suggesting some degree of inter-annual fidelity to summer habitats. The results of this study may be used to guide natural resource management decisions by providing a basic understanding of roost ecology of bats during the maternity period, and the degree of inter-annual fidelity to summer habitats.

Moths to the Light: Nocturnal Insect Diversity at MPG Ranch as Revealed by DNA Barcoding

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We collected nocturnal insects at MPG Ranch in the Bitterroot Valley from May-August, 2017, to establish a DNA barcode reference collection for a project to investigate diet and trophic relationships of nocturnal aerial insectivores. Using mercury vapor and UV blacklights, we collected 946 specimens from nine insect Orders and obtained tissue samples for DNA analysis from 760, with 86% from Lepidoptera (moths). DNA barcode analysis produced 744 sequences that confirmed 365 insect species from 62 families and 251 genera, including 311 moth species from 25 families and 196 genera. Eighty-three percent of moth species were represented in six families: Noctuidae (43.4%), Geometridae (20.5%), Crambidae (5.8%), Pyralidae (5.8%), Tortricidae (5.5%), and Erebidae (4.8%). Pending verification, 75 species are potential new records for Montana and 162 new records for Missoula County. Moths are known to serve as herbivores, pollinators, and food resources. However, only recently has the scale and importance of the roles this taxa serves in ecosystem functions been given serious consideration. This interest has been prompted by significant declines documented in Europe, preliminary evidence of declines of large moths in northeastern United States and adjacent Canada, and the general decline of flying insects in many areas. Our initial research revealed MPG Ranch harbors a rich diversity of moth species. This diversity presents excellent opportunity for long term monitoring of population trends and further research on the role moths play in maintaining botanical diversity, community level responses to land use practices and climate change, and their importance in terrestrial food chains.

The Difficulty of Becoming a Breeding Osprey: Insight from a Telemetry Study Based in Western Montana

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Erick Greene, University of Montana, Missoula

In 2006, we began testing the blood of nestling Ospreys (*Pandion haliaetus*) for mercury and other heavy metals to establish contaminant status, pinpoint pollution hotspots, and assess the success of restoration efforts associated with past mining activities along the Clark Fork River in western Montana. We began using colored leg bands with unique alphanumeric combinations in 2010 to investigate where these Ospreys travel each winter, and where juveniles disperse. We bolstered these efforts in 2012, when we began instrumenting Osprey families from three nests near Florence, Montana with GPS transmitters. To date, we have tracked 10 adult breeding Ospreys and 17 of their young from these nests. As predicted from resightings of our color-banded Ospreys, GPS tracked individuals wintered in Mexico, northern Central America, and along the Gulf Coast. Though approximately half of our GPS instrumented nestlings survive their initial meandering fall migration and first winter, we have yet to document one successfully producing a clutch of their own young. Similarly, we have yet to document a successful nesting effort by any of the 203 color-banded nestlings from our larger regional study. These results may suggest the process of becoming a breeding Osprey is longer and more arduous than we expected when we began our study.

Mountain Goat: Montana's Bipolar Alpine Ungulate

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Among the four states and four Canadian provinces and territories inhabited by native populations of mountain goats, Montana is unique. More than 75 years ago, the state wildlife agency began transplanting mountain goats (495 animals to 27 locations) into previously unoccupied mountain ranges. We gathered and synthesized available harvest and population data for all native and introduced populations across the state. Supplementing these data with responses to a questionnaire we developed and sent to the 18 Montana Fish, Wildlife and Parks' biologists that manage goats, we assessed past trends and the current status of Montana's mountain goats. As introduced populations have generally prospered—numbering 2,525 or 69% of the statewide population—native populations (outside Glacier National Park) have declined from an estimated 4,100 during the 1940s to about 1,160 (31%) of the statewide population in 2016. Many populations are small and potentially demographically isolated. Whereas native herds sustained 80–90% of public harvest 50 years ago, introduced populations have produced about 85% of the statewide harvest in recent years. Total harvest has declined over that period from 300–500 to ~210 goats annually. Our survey of biologists identified likely causes of population changes and a wide range of management and research needs that would benefit mountain goat management. We have recommended development of a statewide plan for the species' long-term management and conservation.

Using DNA Barcoding to Shed Light on the Diet of Nocturnal Insectivores

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Like diurnal animals, nocturnal species partition the environment in ways that allow for multi-species overlap. However, the cover of night obscures many of these interactions. The MPG Ranch in the Bitterroot Valley of western Montana hosts a suite of overlapping nocturnal insectivores, including Common Poorwills (*Phalaenoptilus nuttallii*), Common Nighthawks (*Chordeiles minor*), Flammulated Owls (*Psiloscops flammeolus*), and 11 bat species. All rely on healthy nocturnal insect populations for successful breeding. Though we have a general understanding of the types of insects each species eats, we suspect that dietary composition varies based on foraging behavior. We used DNA barcoding of fecal samples to examine the dietary composition and overlap within this nocturnal insectivore community. We collected 65 fecal samples from Common Poorwills, 21 from Common Nighthawks, 13 from Flammulated Owls, and 92 from seven bat species. We will discuss the amount of dietary overlap between nocturnal insectivores and how any dietary partitioning relates to observed foraging behavior. We will also evaluate the overall effectiveness of DNA barcoding as a tool to determine the diet of nocturnal insectivores and other animal species.

**Spatial Patterns of Winter Roadside Gray Wolf Sightability in Yellowstone National Park

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Imperfect detection is ubiquitous among wildlife research and can affect research conclusions and management. Accordingly, detection probability is often included in observation-based models. Here, we leveraged long-term research of gray wolves (*Canis lupus*) in northern Yellowstone National Park to evaluate how the probability of sighting radio-collared wolf packs from ground-based locations was affected by the characteristics of each spatial location (i.e., distance from the road and viewability [a combination of landscape "openness" and whether visible from a viewshed created from the road and nearby observation points]). To do so, we used 2,681 unique, daily observations of 17 wolf packs collected during 44 unique 30-day winter monitoring periods from 1995 – 2017 and used matched-case control logistic regression with a 1:1 sampling design between observed and random locations. We found that the probability of wolf sightings declined as wolves were farther from the road and increased when wolves were in open, viewable areas. We then evaluated whether these conclusions were affected by wolf group size or whether wolves were feeding at a carcass and found that the probability of sightings only clearly decreased when smaller groups of wolves were farther from the road. Ultimately, we used our results to build spatial predictions for seeing radio-collared wolves in northern Yellowstone National Park. These predictions are useful to managers by identifying "hot-spots" of wolf observations, and can also be incorporated into research related to wolf ecology and predator-prey dynamics that relies on ground-based observations of wolves.

**Hen, Nest, and Poult Survival of Merriam's Wild Turkeys in the Northern Black Hills

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Chad P. Lehman, South Dakota Department of Game, Fish and Parks, Custer

In South Dakota, wild turkeys (*Meleagris gallopavo*) are a high-interest species for consumptive and non-consumptive uses. Harvest records indicate that the population in the northern Black Hills may be declining. Although data on hen survival, nest survival, and early poult survival were collected for the southern Black Hills in the early 2000s, there is currently a paucity of demographic data for the northern Black Hills. We seek to inform management of wild turkeys by characterizing demography specifically for the northern Black Hills. We radio-tracked 149 turkey hens from January 2016 through January 2018 to estimate rates of hen survival, nesting, nest survival, and early poult survival. Based on our initial results, hen survival, nesting, and nest survival may be lower in the northern Black Hills than in the southern Black Hills. Annual hen survival is approximately 45.2%. In 2016 and 2017, 77.5% and 87.5% of adult hens attempted nesting, respectively. We monitored 104 nests (45 in 2016, 59 in 2017) and initial estimates of nest survival were approximately 63.5% in 2016 and 35.3% in 2017. Poult survival to 4 weeks is comparable in the northern and southern Black Hills, but rates in both areas are lower than other portions of the species' range.

Although the northern and southern Black Hills are in close proximity, climatic differences may explain reduced productivity in the northern Black Hills. Examining the role of weather (e.g., spring and summer rain, snow depth, and temperature) on vital rates likely will provide important insights.

Poster Abstracts

Alphabetical By Presenter's Name

In Order of Presenting Author
*** Denotes Presenter**
****indicates student presentation**

**Analysis of Spiny Softshell Turtle Population Structures in Five River Systems in Eastern Montana

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Kayhan Ostovar, Rocky Mountain College, Billings, MT
Andrhea Massey, Rocky Mountain College, Billings, MT
Ulrich Hoensch, Rocky Mountain College, Billings, MT

The spiny softshell turtle (*Apalone spinifera*) is designated as a species of concern in the state of Montana due to a lack of knowledge regarding their conservation status, loss of habitat connectivity and anthropogenic changes in hydrology. Information on population abundance and basic population structure for this species is necessary to understand how altered hydrological regimes and catastrophic events may affect this highly aquatic species. Spiny softshell turtles were studied in five river and creek systems in southeastern Montana. Over three years a total of 553 spiny softshell turtles were captured. The proportion of females to males captured across all five systems was not significantly different between creeks and rivers, with a total of 89.69% females and 10.31% males. We developed four length / age classes (juvenile, sub-adult, reproductive adult, mature adult) based on reported age cohorts from other studies. Numbers of spiny softshell turtles in each cohort were found to be significantly different between the five systems $p < 0.00001$. The Musselshell and Yellowstone Rivers and Pryor Creek had evidence of juvenile age classes and a more even distribution of age classes than the other systems. The Bighorn River had mostly larger adults and the Musselshell River lacked significant numbers of mature adults. Average seasonal water temperatures, timing and magnitude of spring pulse flows, ice cover and scour in winter, and abundance of open gravel bars, should be examined as possible factors which may explain the observed differences in spiny softshell turtle demographic structures on these five systems.

Wolverine Monitoring Using Integrated Camera Trap Station in the Helena National Forest of Montana

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This study tested non-invasive wolverine monitoring methods designed to achieve cost effective collection of robust genetic and natural history data useful for the development of management practices. Historically, wolverine monitoring has used bait stations to collect hair samples, confirm presence, and estimate population sizes. Individual wolverines, their sex and reproductive status can, however, be consistently identified in the absence of DNA samples through photo analysis. Here, Integrated Camera Trap (ICT) stations combined strategically

placed bait and motion-activated trail cameras with construction of wooden frameworks designed to encourage wolverines into upright, bipedal positions. Photographs of the unique ventral pelage markings that distinguish individual wolverines, as well as of sex organs and signs of reproduction were consistently captured throughout the term of the study. Hair samples for later DNA analysis were also collected from gun brushes located on the wooden frameworks. Between January and May 2016, eight ICT stations were deployed evenly across six contiguous cells in a 5 x 5 square mile grid system within the Helena National Forest near Lincoln, Montana. Six of the eight stations successfully attracted two wolverines who collectively made a total of 93 visits over the course of the study. The individuals were successfully identified as male wolverine M6 and female wolverine F7 from a library of photographs. The identity of these individuals was further confirmed through DNA analysis of hair samples collected during the study. In sum, this study supported the ability of ICT stations to collect reliable information on individual wolverine presence, sex, and reproductive status. They are cost-effective and can provide wildlife managers with valuable data.

Estimating Natal Origins of Migratory Juvenile Northern Goshawks Using Stable Hydrogen Isotopes

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Adam Shreading, Raptor View Research Institute, Missoula, MT

From 2004 to 2007, we collected hatch-year feathers from 44 juvenile Northern Goshawks (*Accipiter gentilis*) captured at our Rocky Mountain Front banding station near Lincoln, Montana. Due to the relative scarcity and secretive nature of goshawks, little is understood about their migration patterns or the geographic origins of birds encountered at research sites. Most studies suggest goshawks are partial migrants, often moving <100km, but select band returns and radio and satellite telemetry have shown some individuals occasionally travel thousands of kilometers. We performed a stable hydrogen isotope analysis on the feathers we collected from young goshawks to determine their predicted natal origin. We found that 68% of goshawks had predicted natal origins relatively close to our capture site, 25% from areas in northwestern Canada and eastern Alaska, and 7% somewhere significantly south or east of our capture site. We did not find any significant patterns with sex and passage date or latitudinal origin, nor did we find a meaningful relationship between latitudinal origin and passage date. Our findings support the current understandings of goshawk migration, with a majority of individuals traveling short distances from their natal grounds and a few outliers traveling great distances, not always in a southerly direction.

**The Effect of Wildfire Smoke on Migratory Bird Species Using Nocturnal Flight Call Monitoring

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Vanessa Haflich, Florence-Carlton High School, Florence, MT
Craig Kuchel, MPG Ranch, Florence, MT

Many migratory songbirds travel at night and produce unique calls while in flight. These species-specific calls are referred to as nocturnal flight calls (NFCs) and function as a way for the birds to communicate with other individuals, echolocate, and maintain flock formation in the darker night hours. This study focused on the impact wildfire smoke density had on the frequency of NFCs recorded. The NFCs were recorded using a 21C bucket microphone from Oldbird.org, and placed at Florence-Carlton High School (FCHS), the floodplain of the MPG Ranch, and Seeley-Swan High School (SSHS). The smoke data, provided by the Montana

Department of Environmental Quality (MT DEQ), were collected by monitors located in Florence and Seeley Lake. These monitors tracked the concentration of pollutant particulate matter less than 2.5 microns (PM2.5) produced by the wildfires. No previous research on the correlation between smoke and NFCs has been found. By comparing the frequency of NFCs with smoke particulate density throughout the month of August, we hope to gain a better understanding of the impact wildfire smoke has on NFC production and potentially on migration timing and patterns.

**Bat Roosting and Hibernation in Talus Slopes

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Twelve species of bats are thought to overwinter in Montana, but surveys have found few individuals hibernating within caves and mines. However, bats are consistently recorded on acoustic detectors year round across the state indicating that they are hibernating in other places. There is anecdotal evidence of bats using talus slopes for roosting and foraging, and these features may serve as important hibernacula. Pilot work using mist nets, roost searches, and acoustic detectors, was conducted at 10 sites during summer 2017 to identify active summer roosts and document species within talus slopes. To continue this work and assess what species are hibernating within these features, we placed ten acoustic recorders on talus slopes to record ultrasonic calls during winter in Northwestern Montana. In warm weather during winter, bats emerge from hibernation to drink, so winter activity may indicate hibernacula in proximity to the detectors. These acoustic data will help us estimate species diversity and relative use at each site. Additionally, we assessed attributes that may influence hibernacula suitability including: aspect, talus depth, talus size, air flow from underneath the slope, and daily temperature and humidity. In February, we will retrieve the data and analyze the number and type of calls. We will determine if the average daily number of call sequences correlates with any of the talus attributes or microclimate variables. Our goal for this project is to provide baseline data to assess the impacts of White Nose Syndrome when it reaches the state, and provide previously undocumented hibernation information.

**The Effect of Varying Moon Phase on Nocturnal Flight Calls

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Many avian migrants travel at night to avoid predators and reduce the risk of increased exhaustion during the heat of the day. It is well known that nocturnal flight calls (NFCs) allow songbirds to migrate in the dark while still effectively communicating among their species. What is not understood is what factors influence the production of calls over the course of the migratory season. In 2012, the MPG Ranch in Florence, Montana joined with software developer Harold Mills to design his recording program, Vesper, around their workflow. Vesper has enabled researchers to study NFCs using remote recording devices and online software that allows species to be classified both digitally and manually based on spectrograms of individual calls. By collaborating with MPG Ranch, we hoped to better comprehend the effect of luminosity, determined by varying moon phases, on the frequency of NFCs. With the autonomous recording units set up at Florence-Carlton High School and

the MPG Ranch floodplain monitor, we collected NFC data from Savannah Sparrows, Vesper Sparrows, and Wilson Warblers, and are in the process of analyzing the relationship between their call activity and luminosity.

Reduced Reproductive Success of Gray Catbirds in Western Woodland Habitats Dominated by Edge

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In the western United States, relatively few studies have comprehensively examined songbird performance in fragmented habitat, particularly within naturally fragmented systems. For this study, we compared territory density and breeding success of Gray Catbirds (*Dumetella carolinensis*) from 2014-2016 in the Bitterroot Valley of Montana, between two woodland habitat types: floodplains and naturally fragmented draws. These two habitats fell within the same human-modified landscape, abutting mixed-use grasslands. Yet, they differed in configuration or their spatial distribution. When compared to floodplain birds, results showed that draw birds had larger territories, lower daily nest survival rates, delayed nest initiation patterns and reduced fledgling success. We also collected vegetation data around nests to see if this was a potential mechanism driving the differences across habitat types. We found the percentage of down woody debris and mid-shrub canopy cover were significantly higher in draws than in floodplains. However, neither vegetation variable significantly influenced catbirds' daily nest survival rates. This excluded local vegetation as the driving mechanism behind differences and provided evidence toward configuration. Draws, as thin strips of corridor habitat, contain high amounts of edge and this configuration could lead to an increase in documented "edge effects". Our results corroborate studies in the eastern U.S. which have shown negative impacts from high edge prevalence on songbird reproduction. Overall, this study's results can assist managers in understanding that increasing the amount of edge habitat in human-altered landscapes could have negative consequences on songbird reproductive success.

Ensuring Diversified Funding into the Future by Passage of the Recovering America's Wildlife Act

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The Association of Fish and Wildlife Agencies assembled a panel of 26 national business and conservation leaders in 2015 to recommend a new mechanism to conserve all fish and wildlife. Known as the Blue Ribbon Panel on Sustaining America's Diverse Fish and Wildlife Resources, the group recommended Congress dedicate up to $1.3 billion annually in existing revenue from the development of energy and mineral resources to the Wildlife Conservation and Restoration Program. These funds would be awarded to state wildlife management agencies for wildlife related conservation, recreation and education projects. In Montana, the funds would be used to more fully implement State Wildlife Action Plan priorities including on the ground conservation for a broad diversity of species and habitats. Federal House Bill 5650 "Recovering America's Wildlife" act was introduced during the fall of 2016 then reintroduced in December 2017. If passed and fully funded, the federal act could bring over $29 million dollars annually to Montana but $10 million in non-federal match would be needed each year. Proactive and partner based projects will be critical to ensure the best use of these funds but prior to that a broad based effort to pass the act is needed. Wildlife

enthusiasts, business owners, developers, researchers and others will be needed to argue it is in everyone's best interest to keep wildlife and habitat healthy, keep species from being federally listed, and maintain outdoor education and recreation opportunities.

** Characterizing Rearing Habitat of American White Pelicans Using PIT Tags from Consumed Fish

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Avian predation on wild fish populations can create challenges for wildlife and fisheries managers. Frequently, managers locate and recover indigestible tags to estimate predation rates and inform decisions. We used a similar method to characterize rearing habitat for American white pelicans (*Pelicanus erythrorhynchos*). During summer 2017, we sought to discern the types of vegetation and substrate white pelicans use while nesting on breeding colonies in Canyon Ferry Reservoir, Montana. First, we located passive integrated transponder (PIT) tags from marked wild fish that had been deposited on the islands and recorded the vegetation or substrate type (cobble, mud, nettle, willow, water) for each tag. Most tags were found in cobble and willow (34.3% and 36.6%, respectively) and very few were in water (0.8%) and nettle (5.3%). Second, we sought to estimate detection probability of PIT tags, as some may go undetected, and determine what factors influence whether tags are found. We hid 200 PIT tags, 40 in each of the 5 vegetation/substrate types, and found 78, resulting in an overall detection probability of 0.39 (95% CI = 0.36 – 0.42). After accounting for detection probability, we estimate that pelicans deposited the most tags, and thus were most likely to use willow vegetation (59%), with all other vegetation/substrate types containing ≤17% of deposited tags. Increasing the proportion of PIT tags found will influence estimates of predation and could affect inferences regarding habitat use.

**Characterizing Summer Roosts of Little Brown Myotis and Evaluating the Effects of Mountain Pine Beetle Disturbance

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Mountain pine beetle (MPB, *Dendroctonus ponderosae*) outbreaks have resulted in large-scale changes in forest structure throughout the western United States. These changes can have large impacts on wildlife, but have not been studied in bats. Given that roosting sites may limit the distribution and abundance of bat populations, we aim to 1) quantify characteristics of roosts in forests during the summer and 2) evaluate how the availability of these characteristics changes with different intensities of MPB disturbance. During the summer of 2017, we mist-netted for bats in forests dominated by lodgepole pine (*Pinus contorta*) that exhibited varying degrees of tree mortality due to MPB. Three

bat species comprised 76% of captures: hoary bat (*Lasiurus cinereus*, 12%), silver-haired bat (*Lasionycteris noctivagans*, 29%), and little brown myotis (*Myotis lucifugus*, 35%). Originally, we intended to tag lactating female little brown myotis to characterize maternity roosts. However, all 42 captures of little brown myotis were male. We attached radio-transmitters to 11 males and located at least 1 roost for 6 individuals (total roosts = 18). All roosts were in rock features, even though lodgepole snags were abundant and in close proximity to roosting sites. These preliminary results suggest that in lodgepole-dominated forests, male little brown myotis choose to roost in rock features over snags, regardless of the severity of MPB disturbance.

Examining the Utility of Time to Event Models for Abundance Estimation of a Solitary Carnivore

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Abundance estimation is a common task in wildlife biology, but techniques to estimate the abundance of low density, difficult to detect species, such as cougars (*Puma concolor*), are limited, often requiring intensive field effort and incurring high costs. Remote cameras offer an effective means of detecting these species, but most abundance estimation methods using remote camera data rely on a portion of the population being marked or uniquely identifiable. Methods to estimate the abundance of populations without identifiable or marked individuals using remote cameras have assumptions that are difficult to meet in field studies. The recent application of time to event modelling to abundance estimation relaxes these assumptions, requiring only random movement with respect to the cameras, an estimate of movement rates, and a closed population. I will use simulated walk models to test the robustness of the time to event model to violations of these assumptions likely in field studies. I will apply the model to two cougar populations in central and southeastern Idaho, and compare the abundance estimates to concurrent estimates from genetic spatially explicit capture recapture.

**Snapping Turtle Populations and Movements in South-central Montana

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Snapping turtle (*Chelydra serpentina*) populations were surveyed on a number of tributaries and other water bodies in south eastern Montana along the Yellowstone River in 2016 and 2017. While records exist from incidental observations, systematic surveys for snapping turtles have not previously been conducted in Montana. Little is known about their population density and specific habitat requirements in northern parts of their range. Anthropogenic changes in land use and hydrology may affect nesting sites and hibernacula and thus snapping turtle vital rates, while also impeding metapopulation connectivity or recolonization after localized extinctions. Eighty two snapping turtles (including nine recaptures) were recorded primarily in small creeks, ponds and lakes. Only one snapping turtle was captured on the Yellowstone River though many were found in small tributaries. When analyzed separately capture success rates were significantly different amongst five creeks ($p < .05$) with a higher proportion of males in all populations ($p < .05$). After identifying several creeks with larger numbers of snapping turtles present we fitted turtles over 8 kg with radio transmitters, beginning June 2017. Movements of radio-tagged

individuals were recorded at least monthly to determine average distances moved. Maximum river miles moved per turtle were averaged (females = 0.83 miles and males = 1.21 miles). Low numbers of females could indicate higher female mortality related to risks during nesting such as crossing roads. Snapping turtle abundance was highest in creeks dominated by cattle grazing or agricultural uses. Creeks with lower abundance were dominated by urbanization and higher density of road crossings, potentially leading to increased mortality and lower hatchling success rates.

**Understanding Differences in Nest Site Characteristics Between Juvenile and Adult Turkeys

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Wild turkeys are one of the most-actively monitored and regulated bird species in North America. Data from the northern Black Hills, South Dakota indicate that the turkey population is declining. Nest success is an important driver of turkey populations and previous nesting experience could increase the chances of selecting a nest site where at least one egg hatches. As a result, we were curious if nest site characteristics differ between adult and juvenile hens. We monitored 88 nests and recorded nest fate (success/failure) during two field seasons. We also characterized horizontal and vertical vegetation cover around each nest at the actual or projected hatch date. Of the 43 successful nests (≥1 egg hatched), 33 belonged to adult hens and 10 to juveniles. Of the 45 failed nests, 30 belonged to adults and 15 to juveniles. Successful nests of juvenile hens were in locations with 20.7% greater horizontal total cover (95% CI= 5.7 to 35.7) and 16.6% greater shrub cover (-3.2 to 36.4) than successful nests of adults. However, we did not detect differences in horizontal total or shrub cover for failed nests of juveniles and adults. We also did not detect a difference in vertical vegetation cover between nests of adults and juveniles, regardless of nest fate. Retaining sufficient vegetation cover might help provide habitat features ideal for nesting juvenile and adult hens.

**Grizzly Bear and Human Use at Moth Sites in the Greater Yellowstone Ecosystem

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In the greater Yellowstone ecosystem (GYE), alpine aggregations of army cutworm moths (*Euxoa auxiliaris*) are an important food source for grizzly bears (*Ursus arctos horribilis*). The number of grizzly bears utilizing this food source has increased since initial documentation in 1986 in the Shoshone National Forest, Wyoming. Dozens of bears congregate and feed on moths offering a unique viewing opportunity for bear-enthusiasts, professional media, and hikers. Currently, there is a limited understanding of how bears use these areas and no information on human use. The proximity of grizzly bears and humans poses a management concern for grizzly bears and human safety. Our objectives are to quantify grizzly bear and human use patterns and to identify areas of bear-human interactions. Our methods include occupancy and written surveys, GPS tracking unit deployment, and GIS analysis. Preliminary results from our first year of bear observations (n=220) showed

48% of bears foraging on moths, 20% foraging on vegetation, and 23% travelling. We recorded 5 groups and 26 groups of human use at two locations. We documented 18 bear-human interactions, all on high-use travel routes common to bears and humans. Despite low human use all interactions between bears and humans resulted in bear avoidance of humans. At present, bear-human interactions appear to be very low but if human use increases, interactions will increase due to lack of alternate travel routes.

Clover Trapping Mule Deer in Northwest Montana: Lessons Learned in a Unique Environment

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Mule deer (*Odocoileus hemionus*) populations are in decline in many parts of western Montana, and in 2017, harvest in Montana Fish Wildlife and Parks (MFWP) management region 1 (R1) reached an all-time low. This prompts a need to better understand mule deer habitat selection behaviors in a range of ecosystems. Using resource selection functions (RSFs), we will compare how GPS-collared mule deer select nutritional resources and hiding cover at large scales (home range level) and fine scales (within-home ranges) relative to forage quality in 3 distinct ecosystems throughout western Montana. In February of 2017, we successfully captured 30 mule deer does along the Rocky Mountain Front using helicopter net-gunning, but were unsuccessful in the Whitefish Range and Fisher River drainage of R1 due to dense canopy cover. From December 2017 to present, we have relied on a crew of graduate students, MFWP game wardens and biologists, technicians, volunteers, and private citizens to scout for and clover-trap mule deer in R1. Here we present our capture success rate thus far, though trapping efforts are ongoing. We wish highlight how creative methods and recruitment of help from across a state agency can be pooled to initiate rigorous research in a thickly forested environment on a scarcely seen ungulate.

**Assessing Habitat Quality for Four Grassland Songbird Species of Concern in Northern Mixed-Grass Prairie

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During the past 40 years grassland bird populations have declined faster than any other avian guild in North America. In northern Montana, four species are experiencing dramatic population declines, Baird's sparrow (*Ammodramus bairdii*), Sprague's pipit (*Anthus spragueii*), chestnut-collared longspur (*Calcarius ornatus*), and McCown's longspur (*Rynchophanes mccownii*). In 2017, we began a 2-year field study to evaluate abundance, nest density, and nest survival of these species in relation to local vegetative conditions with the goal of identifying important breeding season habitat conditions to inform species and land management. We conducted fixed-radius point-counts at 50 sites to estimate local abundance, rope drag surveys to estimate nest density and vegetation surveys to estimate vegetation structure and community across grassland habitats in Phillips County, MT. Discovered nests

were monitored to estimate daily nest survival. Habitat conditions including vegetation composition and structure and herbaceous biomass were assessed at both the nest-site and plot scale. We will present preliminary information from our first year of study including effects of local and plot-level vegetation conditions on nest survival for our focal species, effects of vegetation composition and structure on local bird abundance and nest density, and the functional relationships among abundance, nest density, and nest survival of sentinel grassland birds in northern mixed-grass prairie habitat. Initial models suggest that abundance is influenced by visual obstruction, grass cover, slope, and shrub cover, and nest density was influenced by visual obstruction, grass cover, and shrub cover.

Sampling the Grains: Pollen Samples from Hummingbirds

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Hummingbirds transmit pollen both actively and passively while feeding or moving through the landscape. They play a largely undocumented role in plant pollination on their breeding grounds. Many hummingbirds also migrate thousands of miles, potentially transporting pollen greater distances than other pollinators. To investigate the role of hummingbirds in both short- and long-distance pollen transfer, we collected pollen samples from the heads and bills of hummingbirds during migration and throughout the breeding season. We identified the pollen from 44 hummingbirds captured during the 2016 and 2017 field season in western Montana. We also solicited and analyzed 9 samples from southwestern Idaho. Pollen analysis revealed 18 different genera of pollen on sampled hummingbirds, including genera (e.g., Pinus, Larix) that passively broadcast pollen. We detected some pollen from plant species not locally available, suggesting that hummingbirds do transfer pollen long distances, and may serve as vectors for plant genetic diversity. Pollen grains differed in their anatomy and potential for adhesion to hummingbird feathers and bills, suggesting that some pollen is better suited for long-distance dispersal. We plan to continue collecting pollen samples from ours and other sites in the future. We also hope to perform experiments that investigate the role pollen morphology may play in adhesion longevity.

Epaulets in Golden Eagle Plumages in Western Montana

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An uncommon plumage characteristic of North American Golden Eagles (*Aquila chrysaetos*) is the epaulet, a white feather or feathers at the shoulder, often symmetrical on both sides in appearance. The size and shape of an epaulet varies by individual. This characteristic is mentioned within the literature, but is not noted how it is reflected within a population. We have observed epaulets in 17 out of 102 (16.6%) individual Golden Eagles with at least one epaulet in western Montana since 2012. Of these individuals, 13 (76.4%) were observed on the Rocky Mountain Front while on migration, and 4 (23.6%) were observed on wintering grounds in the Bitterroot Valley, Montana. Epaulets have been observed on both male and female individuals, and on both sub-adult and adult aged birds. This plumage characteristic should continue to be recorded in Golden Eagles for a better estimate of rate of occurrence within a population.

Conservation Planning Tools; Free Resources to Facilitate Ecological Modelling and Stakeholder Engagement

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Conservation management decisions are growing progressively more challenging, requiring consideration of ecological, social, legal, and economic factors. Land managers are expected to not only consider a diverse range potential influences and impacts, they are expected to analyze increasingly complex datasets and effectively present the results to a more exacting public audience. Numerous free, online, and open-source tools are available to help with this process, however many land managers are unaware of or unfamiliar with these resources. We present examples of three such tools and demonstrate how they can be integrated to assist with conservation planning, decision-support, and data visualization. Examples include aquatic intactness modelling in the Great Basin region, alternative energy planning in the Mojave Desert region, and forest resiliency modelling in the Sierra Nevada Mountains.

Acoustic Detections of Uncommon Avian Migrants

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During migration, many bird species emit nocturnal flight calls that can be passively recorded, allowing great insight into avian migration ecology. Since 2012, we have used acoustic recorders to look at the composition, timing, and factors influencing avian migration in the Bitterroot Valley of western Montana. Hidden amongst the thousands of expected detections, we found evidence of many unusual or unexpected species. These species include: Barn Owl, LeConte's Sparrow, Canada Warbler, Chestnut-sided Warbler, Grey-cheeked Thrush, Upland Sandpiper, Pectoral Sandpiper, and Greater Yellowlegs. We reviewed observations from eBird, the Montana Natural Heritage Program, and published range maps to provide context for the rarity of detections. Our results suggest that acoustic monitoring may broaden the known distribution of migratory species in ways more traditional methods have not.