ABSTRACTS - ORAL AND POSTER PRESENTATIONS
Alphabetical by Presenter's Name
*Indicates Presenter
**Indicates Student Presentation

Acoustic Monitoring of Bat Species to Support Multi-Scale Monitoring and Conservation

Dan Bachen*, Montana Natural Heritage Program
Alexis McEwan, Montana Natural Heritage Program
Kristina Smucker, Montana Fish, Wildlife and Parks
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With the spread of *Pseudogymnoascus destructans*, the pathogen that causes White-Nose Syndrome, into Montana and the increasing footprint of wind energy and mortality of bats at turbines, Montana's bat species face significant and increasing threats to persistence. Monitoring of species presence and population trend is necessary to assess impacts of these threats and help guide conservation efforts. In 2020 the state, with support from federal agencies and volunteers, conducted surveys using acoustic methods to detect bats at sites across the state. Survey locations were prioritized using the North American Bat Monitoring Program (NABat) sampling grid with four detectors deployed in selected cells over four nights. We surveyed and recorded data at 350 sites within 96 cells and recorded 588,489 call sequences. Automated analysis indicates the detection of 13 species. These data provide information that can be used across management scales. The observations themselves provide managers with confirmation of species presence at the local level and are valuable for project planning. At the regional level these observations can be used to inform species distribution models and explore habitat associations. At the state-wide level analysis of site occupancy and detection probabilities can be used to establish baselines and guide future monitoring to determine trend. As surveys were performed following a national sampling protocol, these data are compatible with other efforts undertaken in states and provinces across the US and Canada as part of the NABat and will be used to provide information on the species across their continental range.

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Assessment of Conservation Status of Montana's Wildlife and Implications for Inventory and Monitoring

Dan Bachen, Montana Natural Heritage Program

The assessment of the conservation status of species provides valuable information for highlighting species that are undergoing declines or are threatened with extirpation in some or all of their range, allowing managers to prioritize actions to support conservation. In Montana, ranks for animals, plants, and ecosystems are calculated by the Montana Natural Heritage Program (NHP) using standardized NatureServe methodologies that account for the species rarity, threats to persistence, and trends in population. For terrestrial vertebrates, proposed changes to ranks and constituent criteria are reviewed by a committee of NHP and Montana Fish Wildlife and Parks staff with consultation of taxonomic experts before final ranks are accepted. Recently NHP staff have undertaken a comprehensive review of the methodology and systems that support rank calculation. During this process we have reviewed the rank data for all birds, mammals, reptiles,

and amphibians, and developed database driven tools to increase the transparency of status ranks and better display this information to wildlife professionals. We identified data deficiencies within these ranks to provide recommendations for future research to address these deficiencies. Across the Species of Conservation Concern reviewed we found that all had data to assess rarity, 48 lacked short-term trend data and 26 more lacked current trend data, and 18 lacked data to assess threats to persistence. Identification of data deficiencies can help structure future research by providing clear goals for baseline inventories, monitoring intervals, collection of life history data and the precision required for any indices used in the ranking process.

**Bumble Bee Selectivity of Native and Non-Native Flowers in Northwest Montana

Rustin Bielski, Salish Kootenai College

Loss of native pollinators can have adverse effects on native plant communities. Likewise, the loss of native plant communities can have adverse effects on our native pollinator community. Non-native flowers have been known to detriment native ecosystems, but how does this affect our native pollinators? Bumble bees are a keystone pollinator in Northwest Montana, but bumble bee species have been declining globally in recent years. This study looks at the preference of bumble bees between native and non-native flowers throughout their foraging season. It incorporates two methods of observations, a focal survey of bumble bee activity, and a sweep net capture. Host plant selectivity is compared to the relative abundance of native and non-native flowers. In total, 133 bees were recorded, 59% seen on native flowers and 49% on non-native. The data shows a clear preference towards native flowers throughout the season.

Part I: Tracking Small Wildlife Migration Collaboratively Across the West

William Blake*, MPG Ranch
Kate Stone, MPG Ranch

Wildlife movement, including migration, influences the ability for species to adapt and survive. Without a better understanding of movement and connectivity, most species-focused conservation strategies may not reflect full annual cycles. The Motus Wildlife Tracking System, or Motus, helps to fill that void by deploying miniaturized and digitally encoded VHF tags on wildlife, called Motus tags, in combination with strategic placement of automated receiving units, called Motus stations. In fall of 2018, MPG Ranch spearheaded the “Intermountain West Collaborative” (IWC) Motus Project aiming to expand the western Motus network for all researchers to use. In 2019, the IWC Motus Project grew a network of 12 Motus stations in western Montana and researchers tagged 120 birds and bats. The following year, IWC expanded the array to 23 Motus stations across Montana, Idaho and Oregon, and increased tagging efforts to more than 200 birds and bats. We have detected various species during migration, using this technology, renewing our appreciation for connectivity and our understanding of movement of small wildlife. The Motus network expansion in the West speaks to the collaborative interest

many biologists and conservationists hold in unravelling migratory habits of small wildlife and conserving their habitat. In 2021, we are planning to install an additional 20-30 Motus stations throughout the West and as far as Mexico. The flourishing Motus projects in our region will provide species life-history information such as dispersal, survival, departure and arrival dates, and a better understanding of wildlife habitat connectivity throughout the West.

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Montana’s Non-bat Cave Life: Incidental Observations and Informal Studies by the Bigfork High School Cave Club

Hans Bodenhamer*, Bigfork High School Cave Club
Jayda Anderson, Bigfork High School cave Club
Jessop Lochlan, Bigfork High School cave Club

The Bigfork High School Cave Club, as a result of their involvement with bat studies related to White Nose Syndrome, have accrued numerous incidental observations of wildlife use of Montana caves. Observations include use of caves by wood rats, bears, wolverine. mountain goat, bighorn, sheep, marmot, porcupine, and other species. The club has conducted two informal microinvertbrate studies, one noncollecting study of amphipods, planaria and isopods in caves on Glacier National Park and another statewide study for which

macroinvertebrate specimens are being archived at Montana State University for eventual identification and further study.

**Comparing Fence Modeling and Mapping Approaches to Support Wildlife Management and Research in Southwest Montana

Simon Buzzard*, University of Montana, Environmental Studies Program
Andrew Jakes, National Wildlife Federation
Amy Pearson, The Nature Conservancy
Len Broberg, University of Montana, Environmental Studies Program, Missoula

Fences pose significant challenges to wildlife movement, but their effects are difficult to quantify because fence location and fence type data are lacking on a global scale. We developed a fence location and density model in southwest Montana, USA to provide data to researchers and managers, and test whether previous models could be applied to a new region and retain suitable levels of statistical accuracy. Our model used local expert opinion to inform how road, land cover, and ownership spatial layers interacted to predict fence locations. We validated the model against fence data collected on random 3.2 km road transects (n = 330). The model predicted 37,687 km of fences across the study area, with a mean fence density of 1.6 km/km^2 and a maximum density of 11.3 km/km^2. Additionally, we manually digitized fences in Google Earth Pro in a random sample of 50 survey townships (roughly 4,650 km^2) within the study area and validated the accuracy of this method to compare results against the fence model predictions. Our fence model showed lower agreement (Cohen's Kappa = 0.56) with known samples than manually-digitized fences in Google Earth (Cohen's Kappa = 0.76), yet had an improved level of accuracy over previous models. The fence model outputs are likely most useful for large scale analyses of ecological influences of fence densities, whereas the Google Earth digitizing method is likely useful to locate individual fences for fine-scale analyses.

Attitudes of Montanans Regarding Grizzly Bears and Their Management

Cecily Costello*, Montana Fish, Wildlife & Parks
Holly Nesbitt, University of Montana, Missoula
Alexander Metcalf, University of Montana. Missoula
Elizabeth Metcalf, University of Montana, Missoula
Lori Roberts, Montana Fish Wildlife and Parks
Justin Gude, Montana Fish, Wildlife and Parks
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In 2019-20, a collaborative study was conducted by Montana Fish, Wildlife & Parks (FWP) and the University of Montana to better understand Montanans thoughts about grizzly bears and grizzly bear management in Montana. Survey findings revealed generally positive attitudes towards grizzly bears. Despite a high level of support for the presence of grizzly bears in Montana, results from this survey demonstrate that acceptance of bears declined relative to human occupancy and agricultural-ranching use of the landscape. Montanans' views were mixed regarding whether grizzly bears should be allowed to live anywhere they become

established on their own. Most Montanans agreed grizzly bears numbers are expanding in Montana. However, a large percentage of Montanans reported knowing little about grizzly bear numbers across different geographic areas of the state, and the remainder expressed views across a spectrum from "much too low" to "much too high". There was generally wide support for hunting this species, with half of Montanans reporting they support enough hunting to manage their population size. About 17 percent of Montanans believe grizzly bears should never be hunted. Montanans reported diverse beliefs regarding the success of grizzly bear management and their satisfaction with that management in Montana. However, trust in FWP to manage grizzly bears was relatively high. The results from this important study will be used by FWP as part of ongoing efforts to include public input in grizzly bear management decision-making processes going forward.

**Natural and Anthropogenic Landscape Features Influence Greater Sage-Grouse Seasonal Habitat Selection in Carbon County, Montana

Erin Gelling*, University of Wyoming, Laramie
Aaron Pratt, George Miksch Sutton Avian Research Center
Jeffrey Beck, University of Wyoming, Laramie

Quantifying resource selection by animals assists wildlife and land managers in making habitat decisions that can be used for restoration and conservation planning. Greater sage-grouse (*Centrocercus urophasianus*; hereafter 'sage-grouse') are the focus of much research and conservation efforts owing to their obligate relationship with sagebrush (Artemisia spp.) and dramatic population declines over the last 50 years. Sage-grouse typically utilize different habitats during breeding, summer, and winter seasons and resource use varies throughout the home range of an individual animal. Our objective was to identify natural and anthropogenic landscape features that influence resource selection for female sage-grouse during breeding, summer, and winter seasons. We used data from 85 GPS-tagged female sage-grouse in Carbon County, Montana and Park County, Wyoming from April 2018–2020. We examined resource use based on intensity of use by implementing a Resource Utilization Function (RUF) for each season. We identified natural landscape features from remotely sensed data and identified anthropogenic features such as roads, oil and gas development, agriculture, and houses. We evaluated each variable at multiple scales ranging from 100 m to 3200 m across each season. We found differences in sage-grouse resource use based on scale and season. Wildlife managers should consider not only seasonal habitat used by sage-grouse, but also those areas that are used most frequently and the habitat characteristics associated with increased areas of sage-grouse use.

**Wild Ruminants Variably Possess a Rumen Microbial Metabolism that Degrades the Toxic Alkaloid Methyllycaconitine

Savannah Grace*, Montana State University
Carl Yeoman, Montana State University

Tall Larkspur (Delphinium spp.) grows abundantly in the North-western United States, where it presents a serious toxicity danger to rangeland cattle. Consumption of the toxic alkaloid, methyllycaconitine (MLA) found in Tall Larkspur causes an estimated loss of 5-15% of rangeland cattle annually. While detrimental to the agriculture community, cattle mortality due to larkspur poisoning is also of concern for wildlife and land managers, as livestock carcasses attract predatory animals to public lands creating unsafe conditions for recreationists. Due to the wide distribution of Larkspur, wild ruminants in the western US must also be exposed to larkspur while foraging, however, there is no evidence to suggest these species are affected by their toxic alkaloids suggesting they may be less sensitive to MLA. We hypothesized that wild ruminants possess a gut microbial metabolism capable of degrading MLA. Foregut samples were collected from each of Montana's wild ruminant species by volunteer hunters and assayed for total alkaloid- and MLA-degradation activities over 48 hours in in vitro incubations. Separate incubations were performed to assess the relative influence of gut bacterial, fungal, and abiotic activities. Prior to and following incubations total alkaloid was extracted and measured spectrophotometrically and MLA was measured by High-Performance Liquid Chromatography Mass Spectrometry (HPLC), respectively. Preliminary analysis has demonstrated alkaloid degradation occurs in the majority of wild ruminant species at varying levels. Based on these findings, we believe wild ruminant species may provide novel microbial metabolisms that may be developed to benefit both the livestock industry and minimize human:carnivore conflicts on overlapping public lands.

Mountain Goat Declines in Glacier National Park Associated with Early Summer Precipitation and Temperature

Tabitha Graves*, U.S. Geological Survey
Jami Belt, U.S. Geological Survey
William Janousek, U.S. Geological Survey
Michael Yarnall, MT Fish Wildlife and Parks

A shifting climate poses threats to alpine-adapted species including mountain goats. We used a 12-year citizen science dataset and a Bayesian N-mixture model to examine population trend of mountain goats in Glacier National Park. Median goats per site declined by 45% (95% CRI = 32%, 57%) from 77.8 (95% CRI = 64.4, 95.1) in 2008 to 42.3 (95%CRI = 34.3, 52.2) in 2019, with detectable consistent declines from 2008 until 2015, when numbers stabilized. These declines exceed IUCN criteria for vulnerable, with >30% declines over only 2 generations. Climate variables had the greatest influence on population growth rate, particularly precipitation between May 15 and June 15 of the previous summer. Higher growth occurred with greater snow water equivalent, mean winter temperature, early summer temperature and early summer precipitation. In addition, the presence of permanent snow and glaciers strongly influenced initial abundance of goats. We are not able to determine the relative contribution of vital rates to this apparent decline. However, the patterns of decline are consistent with other data sources. Research to estimate the population size, evaluate genetic structure, assess changing habitat,

human recreation and forage, and to forward project climate effects on persistence will be crucial to conserving this iconic, meta-population at the southern edge of the distribution of native mountain goats.

Montana Fish, Wildlife and Parks' Strategy for the Conservation of Wildlife Movement and Migration

Lauri Hanauska-Brown*, Montana Fish, Wildlife and Parks
Justin Gude, Montana Fish, Wildlife and Parks
Renee Lemon, Montana Fish, Wildlife and Parks
Brian Wakeling, Montana Fish, Wildlife and Parks
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Conservation of wildlife habitat is a core function of Montana Fish, Wildlife and Parks (FWP) dating back to 1940 when FWP first pursued conservation of high-value habitats. A critically important role of quality habitat is providing space and security for animals to move across the landscape to utilize seasonally important resources. FWP has been working with private landowners, federal agencies, the Montana Department of Transportation, and other partners to facilitate wildlife movements and conserve important habitats. In 2018 the U.S. Department of Interior (DOI) issued Secretarial Order (SO) 3362, which charged DOI agencies to work with 11 eleven western states to conserve winter range and migratory pathways for ungulates and allocated millions in funding. Montana has received more than $1.5 million and used those dollars to continue collaring ungulates, remove fencing, manage weeds, and conserve important parcels of land. FWP released the first SO 3362 Action Plan in 2018 to prioritize work and in 2020 released a strategy formally defining and prioritizing agency efforts related to big game, carnivore and bird movements, commensurate with long-standing efforts by FWP and our partners. FWP is involved with teams of others working on this issue including the Wildlife and Transportation Steering Committee, the WAFWA Wildlife Movement and Migration Working Group and the Migration Coalition. FWP specifically brings to the table a depth of experience working in collaboration with private landowners and state and federal agencies on habitat conservation and now specifically the conservation of wildlife movement and migration.

**Sage-Grouse Seasons, Home Ranges and Habitats, What are They and How Many are There?

Trapper Haynam*, Montana State University, Bozeman
Lance McNew, Montana State University - Wildlife Habitat Ecology Lab, Bozeman
Michael Borgreen, Bureau of Land Management
John Carlson, Bureau of Land Management

The greater sage-grouse (*Centrocercus urophasianus*) is a gallinaceous bird that has become a focal species in the conservation effort to preserve imperiled sagebrush ecosystems and associated organisms. Each remaining sage-grouse population across the current range-wide distribution occupies unique environments and must cope with novel combinations of stressors

making it crucial to identify and understand local wildlife-habitat relationships to which management actions may be tailored. Wildlife-habitat responses are typically inferred from population-level survival or resource selection models without regard for detailed individual- or population-level movement patterns. Improved spatial generality of inferences may be gained by linking habitat response associations with specific behaviors or activity signatures (statistical behaviors) derived from movement data and expert knowledge. Our primary goal was to quantify sage-grouse space- and time-use signals relevant to management and parse variability in these signals into components due to spatial (landscape elements) and temporal (seasonality) characteristics, while accounting for individual-level variation. We attached a 22-g solar powered Global Positioning System (GPS) Platform Transmitting Terminal to 86 female sage-grouse in north-central Montana. We monitored females and analyzed movement behaviors using a combination of field observations, nonlinear-regression movement models, multivariate clustering techniques, and a time-local convex hull approach. Time-local convex hulls can be thought of as many brief-duration home ranges from which time- and space- use metrics can be calculated. We will present results from our north-central Montana sage-grouse movement ecology research including migration patterns, diversity of movement modes, seasonal space- and time-use patterns, and seasonal landscape-element associations.

**Anthropogenic Effects on Grouse Detection and Abundance Based Upon Road and Trail Characteristics in Western Montana

Olivia Jakabosky*, Montana State University - Wildlife Habitat Ecology Lab, Bozeman
Claire Gower, Montana Department of Fish, Wildlife, and Parks, Bozeman
Elizabeth Leipold, Montana State University - Wildlife Habitat Ecology Lab, Bozeman
Lance McNew, Montana State University - Wildlife Habitat Ecology Lab, Bozeman

Anthropogenic structures, such as constructed roads and trails, and human use may affect space use, demography, and other wildlife population parameters. Alternately, human infrastructure and activity may result in perceived population responses by influencing the ability of biologists to detect individuals during standard population surveys. The evaluation of spatio-temporal factors correlates in detection probabilities and local abundances, which is necessary for proper population management. To evaluate the effects of human use on mountain grouse populations, we developed and conducted replicated surveys throughout western Montana during 2020. Biologists and volunteers collected count data for dusky, ruffed, and spruce grouse during 582 surveys along 291 survey transects located throughout FWP Regions 1-5. Survey transects occurred along two types of human infrastructure: U.S. Forest Service Trails and unimproved roads close to highway vehicle use during the survey period. As a first step, we compared count data for road and trail transect surveys for each species of grouse. Overall, raw counts of dusky grouse were higher for transects located along trails (0.59 ± 1.07SD grouse per transect) than unimproved roads (0.33 ± 0.91SD). Raw counts of ruffed grouse were similar for transects located along trails (0.75 ± 1.42SD) and unimproved roads (0.69 ± 1.55SD). Sample sizes for spruce grouse precluded comparison. In the next phase, we will use hierarchical models to evaluate whether the apparent effect of trail type on raw counts is manifested through effects on local abundance or the probability of detection, and consider the effects of other human-use and habitat characteristics.

Wildagg: An R Package to Simplify Wildlife Aggregation Analyses

William Janousek*, U.S. Geological Survey
Tabitha Graves, U.S. Geological Survey

The package `wildagg` is an R package designed to estimate, summarize, and visualize wildlife aggregation metrics using location information like GPS collar data. The motivation for the development of this package began with two research efforts studying the aggregation and density of elk on the National Elk Refuge, WY. We applied lessons learned to create a straightforward implementation for users that have a limited level of knowledge of R and related analyses. The package has three primary functions. The first is to calculate daily inter-animal distances for a population of collared individuals, second to estimate the dynamic interaction between pairs of animals based on the proportion of time spent per day within some distance buffer, and third to calculate kernel density estimates across temporal scales. All three of these metrics are useful in determining degrees of animal aggregation or density and provide a variety of avenues to derive potential mechanisms to explain observed aggregation patterns. The framework we present supports the evaluation of temporally varying management actions that influence aggregation broadly and can be easily implemented to answer questions related to disease transmission, human-wildlife conflict, or inter-species competition.

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**First Off-host Survey for Winter Ticks (Dermacentor albipictus) in the Western United States

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Aly Courtemanch, Wyoming Game and Fish Department
Ben Wise, Wyoming Game and Fish Department

Shiras moose (*Alces alces shirasi*) hunting success in parts of Wyoming, Idaho, and Montana has declined over the past decade indicating a potential regional population decrease. Several likely contributing factors such as increased road mortality, habitat changes, and predation have been researched, but few studies have investigated the synergistic threat from climate change and parasites. The winter tick (Dermacentor albipictus) is a well-known ectoparasite of moose which has caused population declines during epizootic years in the Northeast and Midwest, but little is known about winter tick infestation impacts on Shiras moose and which environmental variables may drive epizootics in the Rocky Mountain West. In this study we conduct the first survey for the environmentally vulnerable off-host stages of winter ticks in Shiras moose habitat in Jackson Hole, Wyoming. Our objectives were to 1) verify the efficacy of known winter tick survey techniques in the West, 2) record the questing window for host-seeking larvae, and 3) identify potential environmental correlates with winter tick distribution, abundance, and activation. Winter ticks were first detected on September 21st and remained active until survey efforts halted on November 24th. Of the more than 7,000 ticks

collected, 67% came from grasses or forbs, 19.4% from non-willow shrubs, and 13.6% from willow. Larvae were found questing on vegetation protruding from deep snowpack in temperatures as low as 5º C. Data on questing window and microclimate thresholds can be used to model winter tick epizootics in the future under different climate scenarios while habitat associations can be used by moose managers to target conservation interventions.

**Bull Elk Survival, Vulnerability, and Antler Size in a Transboundary Elk Population

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Evelyn Merrill, University of Alberta, Biological Sciences Program
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Migration is a behavioral strategy used to access resources or avoid predation in spatially and temporally heterogenous landscapes. On the eastern slopes of the Rocky Mountains, elk migrate to higher elevation summer ranges to access higher forage quality and avoid predation risk. Thus, the decision to migrate has both individual and population level consequences. Antler growth and development is driven primarily by age and forage quality. Thus, if migratory animals can gain access to higher quality forage and avoid predation, migratory males will have higher fitness than residents. However, migration often results in transboundary populations being exposed to different levels of harvest as they move across the landscape. Our goal was to investigate these potential drivers of male elk survival and antler size in a transboundary, partially migratory population in a multi-carnivore system. We collared 75 bull elk in 2018-2020 for a total of 105 elk-years (?x=35 collars/year). Male elk survival and antler size was largely a function of age. Human harvested was the primary cause of mortality(n=33) with wolf predation having little effect on survival (n=2). Antler-point-restrictions resulted in low yearly survival rates for male elk over 4 years of age (S=0.42). While migration itself did not enhance antler size or survival, we found a negative effect of increasing forage biomass (and hence decreasing forage quality) on antler size. These advancements will help managers to understand how vulnerability to natural and human predation risk affects male elk age structure and antler size.

**Evaluation of Herbicide Treatments in a Large Oligotrophic Lake to Reduce Aquatic Invasive Species

Ian McRyhew, Salish Kootenai College

The goal of our research is to develop a herbicide prescription to reduce the abundance of flowering rush (*Butomus umbellatus*), and stop the advancement of infestation downstream into the Columbia River Basin. Flowering rush is an invasive aquatic plant introduced to North America from Eurasia, and was observed in Montana, on the northwest shore of Flathead Lake in 1964. Since then, flowering rush has become well established in Flathead Lake and spread downstream through the Selish, Ksanka, Qlipse (SKQ) Dam to the lower Flathead River and

Clark Fork Rivers, and has established in Lake Pend Oreille; furthermore, moving into Washington and Oregon to the McNeary Dam region. Environmental impacts of flowering rush include threats to native fisheries that have considerable cultural importance to the indigenous people of the region. Habitat changes from open water system to closed water system favor invasive species of fish. The alterations to the food web affect macro invertebrates and algae production. In addition to native plants and animals, flowering rush invasions impact property values and recreation, degrade water quality, increase sedimentation, and reduce irrigation water delivery capacity. Two aquatic herbicides, Imazapyr (Habitat®) and Imazomox (Clearcast®), have been applied to bare ground in mid-April, annually, approximately three weeks before inundation. Sprout counts and rhizome weights have been collected in 2017, 2018, and 2019, and compared with existing data for their efficacy. Results have shown that sequential application of aquatic herbicides is an effective means to reduce and deplete the rhizome of flowering rush.

Montana's Integrated Monitoring in Bird Conservation Regions Program (IMBCR) - Monitoring for Management and Conservation

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Jay Carlisle, Intermountain Bird Observatory- Boise State University
Matthew McLaren, Bird Conservancy of the Rockies

Conservation partners have conducted landbird monitoring across Montana, under the Integrated Monitoring in Bird Conservation Regions (IMBCR) program, since 2009. Today, the IMBCR program represents the most rigorous breeding landbird monitoring program in the US. IMBCR is made possible via a broad partnership of multiple government and non-government agencies from the Great Plains to the Intermountain West. The sampling framework allows for inference about avian populations at multiple scales, from a National Forest or Bureau of Land Management field office, up to the state and even ecoregion level. The state of Montana is stratified into over thirty different management areas based on partners' needs and interests. Each year, landbird density and occupancy estimates are produced for individual management areas, which are combined to produce regional estimates. Bayesian analyses provide robust estimates of population trend over time and a new online tool will provide habitat-specific population estimates for each management area. Managers can use these baseline estimates and habitat-specific information for project-level planning and environmental assessments. The IMBCR program provides context for targeted effectiveness monitoring in project areas to evaluate impacts of land-use change or conservation actions. We highlight several case studies from the Intermountain West, where short-term monitoring efforts leverage the long-term data from IMBCR to evaluate avian response to land management practices.

Evaluation of Iridium-transmitted GPS Telemetry Data for Use in Assessments of Wildlife Space Use

Charlotte Milling*, Ohio State University
Shane McKenzie, Ohio State University
Stanley Gehrt, Ohio State University

Remote transmission of GPS data from free-ranging animals provides insurance against data loss and near real-time knowledge of animal location. Miniaturization of batteries and processors have made this technology accessible for smaller-bodied animals, which behave and use space differently than larger-bodied animals. This feature of small animals could result in biased transmitted datasets which could propagate to the inferences we draw from movement behavior for management and conservation. Using free-ranging animals and stationary trials, we investigated the quality of data transmitted via the Iridium network relative to the stored-on-board (SOB) dataset and determined whether inferences regarding behavior and space use are dependent on the quantity of data recovered. We also determined whether Iridium transmission rates were collar-specific and therefore repeatable. We deployed Lotek Litetrack-150 collars on 10 free-ranging raccoons in Manitoba, Canada in spring and summer 2019 and conducted stationary trials outside Chicago, IL in spring 2020. We found no difference in precision (DOP) or quality of data (3D locations), estimated size of the home range, or habitat use ratios between the SOB and Iridium-transmitted datasets. However, only home range sizes estimated using an autocorrelated kernel density estimate were consistent across all data recovery levels. Transmission rates during the stationary field trials were variable and not a repeatable element of our collars. This work highlights the necessity of pre-deployment evaluation and error calibration of collars, as well as the importance of using analytical methods that account for the autocorrelated nature of clustered, Iridium-transmitted data in wildlife studies.

The Emerging Conflict of Common Ravens Roosting on Transmission Line Towers

Marco Restani*, NorthWestern Energy
James Lueck, NorthWestern Energy

Bird interactions with power lines can cause faults, which are a disruption of electrical service. Faults of unknown origin on 500kV transmission lines in central Montana, which are integral to the Northwest US power grid, became an operational concern during winter 2016–2017. In 2017 we found tower insulators heavily contaminated with bird droppings and discovered a large nocturnal roost of common ravens (*Corvus corax*). We summarized fault data from the Energy Management System and raven abundance data from the Billings Christmas Bird Count to assess the potential impact of raven roosts on the transmission lines. We also conducted counts at seven roosts during winter 2019–2020. We found a positive relationship between the number of faults reported and raven abundance from 2005–2020. The three largest roosts peaked at 1,000–1,500 ravens on single evenings. The number of faults during winter 2019–2020 decreased after installation of silicon-coated insulators and perch deterrents, and the periodic washing of insulators. Raven populations have increased significantly throughout their range and may cause similar conflicts for other electric utilities on large transmission lines. Long-term management of ravens will need to integrate approaches at both local and landscape scales.

Sampling for Rocky Mountain Tailed Frogs in Overwhich Creek Post Rotenone Treatment

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

Rocky Mountain Tailed Frogs (*Ascaphus montanus*) are widely distributed and relatively common west of the Continental Divide in small, high elevation streams with cobble substrates. Montana Fish Wildlife and Parks (MFWP) used the piscicide Rotenone to remove non-native Yellowstone cutthroat trout from the headwaters of Overwhich Creek in the Bitterroot Mountains near Lost Trail Pass in 2017, 2018, and 2019. Pre-treatment surveys for amphibians were not conducted in 2017 and 2018, but fisheries biologists anecdotally reported large numbers of Rocky Mountain Tailed Frog larvae dying during treatments, and that the number of tailed frogs appeared to decline after the first two treatments. Prior to the 2019 treatment, an MFWP and Montana Natural Heritage Program crew used kicknet surveys to sample twenty-three 10-meter stream reaches in the treatment area to document the number and age distribution of tailed frog adults, juveniles, and larval classes. This survey found all age classes distributed throughout the treatment area associated with cobble substrates, but densities appeared to be greatly reduced from those reported by fisheries biologists prior to the 2017 treatment. A caged study that measured survival of all age classes during the treatment indicated high mortality rates, but some larvae did survive. A 2020 repeat kicknet survey also showed all age classes to be widespread in the treatment area. Several more years of survey are needed to document recovery post-treatment in Overwhich Creek and more thorough pre- and post-treatment surveys are needed in other streams slated for Rotenone treatment where tailed frogs are present.

**Sex-based Differences in Disease Transmission May Affect Management Efficacy of Chronic Wasting Disease

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Chronic wasting disease (CWD), a pathogenic prion affecting Cervidae, has repeatedly been observed at higher prevalence among males than female deer. This sex bias is potentially due to differences in susceptibility or transmission, but the underlying mechanism may not be discernable from prevalence data alone. We used an age- and sex-structured simulation model to explore harvest-based management of CWD under three different transmission scenarios that all generated higher male prevalence: (1) increased male susceptibility, (2) high male-to-male transmission, or (3) high female-to-male transmission. Heavily male-biased harvests were typically able to control CWD epidemics and maintain host population sizes under high male-to-male transmission and high male susceptibility scenarios. However, male-biased harvests were ineffective under high female-to-male transmission and female-biased harvests were required to limit disease transmission but resulted in low population sizes. Higher disease prevalence in a

sex or age group may be due to higher exposure or susceptibility but does not necessarily indicate if that group also is responsible for more disease transmission. We showed that multiple processes can result in the pattern of higher male prevalence, but that population-level management interventions need to focus on those groups responsible for disease transmission not just those that are most exposed. Disclaimer: This will be presentation from a draft manuscript. Its content is deliberative and predecisional, so it must not be disclosed or released by reviewers. Because the manuscript has not yet been approved for publication by the U.S. Geological Survey (USGS), it does not represent any official USGS finding or policy.

**Suitable Spiny Softshell Turtle (Apalone spinifera) Nesting/Basking Habitat Availability in Dammed and Undammed River Systems

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Riverine turtles are highly adapted to habitats created by the dynamic nature of free-flowing rivers. Dam-regulated flows may decrease suitable habitat for many species, such as the spiny softshell turtle (*Apalone spinifera*). We examined nesting habitat (sand and gravel bar) availability and the reproductive potential of spiny softshell turtles in the dammed, Bighorn River and undammed, Yellowstone River. As a preliminary test, we used ArcGIS and publicly available NAIP data to classify and analyze suitable spiny softshell turtle habitat on 20-mile stretches of both rivers near their confluence. We determined the population demographic structure from 485 turtles captured during six years of surveys. Our goal was to assess whether nesting habitat availability correlated with the population demographic data. Overall, adult spiny softshell turtles appear healthy and of similar sizes on both rivers, yet there is a concerning lack of recruitment and abundance on the Bighorn River. We found significant differences in several metrics of nesting habitat availability between the Yellowstone and Bighorn rivers. On the Bighorn River, limited nesting habitat correlated with very low numbers of juveniles, recently recruited size classes, and males. Through a better understanding of the effects of dams on spiny softshell turtle population persistence, changes in management can be explored to enhance riverine turtle conservation and other species with similar life-history strategies.

Tipping the Scales for Conservation: Leveraging USDA Farm Bill Funding to Conserve Grassland Habitat and Build Working Partnerships

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North American grasslands have and continue to decline at an alarming rate, with a conversion rate of 1.2 million acres of land per year. Coinciding with this extreme loss of habitat, grassland birds have been identified as one of the fastest declining avian suites, with a 53% reduction in population since the 1970's. Most grasslands, meanwhile, remain under private ownership making the conservation of private lands through partnerships with agricultural producers ever more critical. In July 2020, Bird Conservancy of the Rockies, in partnership with

the Natural Resource Conservation Service and Montana FWP, developed a Targeted Implementation Plan (TIP) in Dawson County under the USDA Farm Bill. This program leverages federal funds to assist producers in restoring cropland back to perennial cover for wildlife, while also developing fencing and water infrastructure for livestock to allow these restored grasslands to be productive grazing lands for producers. During the 2021 application period, the program received five applications resulting in approximately 1,300 acres planned for restoration back to grass. Plans are set to be ranked in March, and pending funding, will be implemented beginning as soon as spring of 2021. Building off the momentum of this TIP, a questionnaire to gage interest in a second funding pool was sent to producers in another part of Dawson County in winter 2020, with a goal of creating more grassland connectivity. Producers demonstrated a positive response to the questionnaire, resulting in the ongoing development of another proposal to restore grasslands in the northern portion of Dawson.

Invasive Annual Grass Management Successes: A Wildlife, Pollinator, and Wildfire Perspective

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Invasive winter annual grasses (WAGs) such as cheatgrass, medusahead, and ventenata continue to negatively impact Montana Rangeland. Impacts include displacement of species diversity, displacement of critical wildlife and pollinator habitat, and a drastic increase in fine fuels associated with wildfire. Since beginning in 2015 in collaboration with all the major Universities in the west including Montana State University, over 100 research trials and operational treatments have been implemented with a new WAG tool, Rejuvra. Rejuvra is a new mode of action to land managers that provides multiple years of WAG control with a single application. This allows for the depletion of the WAG soil seed bank, ultimately increasing our restoration success. One concern of land managers, ecologists, and wildlife biologists is the ever-increasing threat of WAGs, the possible permanent displacement of these in-tact ecosystems, and wildfire risk. Several research sites have included lowland, foothills and mountains properties that provide critical overwintering habitat for mule deer, elk, and other wildlife, and treated areas have provided the opportunity to answer several research questions of interest to land managers. Our research has shown that mule deer browse for seven different shrub species and forb forage dramatically increased where cheatgrass was controlled. Invasive WAG treated sites have also resulted in an increase in pollinator habitat and visitation, and fine-fuel loads are greatly reduced. These results reinforce the findings of field managers, that cheatgrass and other invasive WAGs pose a significant threat to the habitat and population of browse and pollinator species in the west.

A Multi-Model Approach to Estimating Wolf Abundance in Montana

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Estimating wolf (*Canis lupus*) abundance is a key component of wolf management in Montana. We developed a multi-model approach to estimate wolf abundance. Our approach eliminates the need for intensive field-based monitoring and introduces biological models of wolf behavior. An occupancy model first estimates annual wolf distribution, based on environmental covariates and wolf observations reported by hunters. A mechanistic territory model predicts territory sizes using simple behavioral rules and limited data for prey resources, terrain ruggedness, and human density. Together, these models predict the number of packs in a given area. Finally, a pack size model demonstrates that pack sizes are generally negatively related to terrain ruggedness, local mortalities, and intensity of harvest management. Total abundance estimates are derived by combining the predicted number of packs and pack sizes. We applied the models to estimate wolf abundance for 2007 – 2019. The population was estimated to have been smallest in 2007, with 91 packs (95% CI = 76 – 107) and 650 wolves (95% CI = 547 – 771). A peak appears in 2011, with a high of 187 packs (95% CI = 170 – 206) and 1254 wolves (95% CI = 1136 – 1383). This coincided with the first years of harvest management, after which the population declined by 7.8% in total abundance between 2011 and 2019. From 2016 – 2019, the population appears to have become somewhat stabilized with an average of 190 packs and 1136 wolves per year, even with an estimated annual harvest rate of >20% in this period.

Enhancing Reasoning and Judgment to Improve Research, Management and Implementation

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Designing research and interpreting findings requires sound reasoning. Implementing results through management requires good judgment. Enhancing the intersection of research, management, and implementation requires wildlife professionals to improve reasoning and judgement skills. Our team conducted a study to identify the essential habits of mind and practices associated with the reasoning and judgement of a sample of peer-selected, highly effective wildlife professionals. Their habits and practices fall into five broad categories: being critically inquisitive and continuously learning; using multi-level, integrative systems thinking; apply self-discipline; taking a balanced approach; and employing emotional intelligence in interactions with others. Based on these findings, we developed a series of practical tools individuals can use to assess the degree to which their habits and practices align with those of highly effective wildlife professionals and develop professional development plans to improve

their performance. The tools are available for use at no cost on the Association of Fish and Wildlife Agencies' Management Assistance Team (MAT) website. MAT staff can provide assistance with use of the tools as well as creation and implementation of professional development plans.

Assessing the Presence and Impacts of White-nose Syndrome on Montana's Bat Populations through Disease Surveillance and Long-term Acoustic Monitoring

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White-nose Syndrome (WNS) is a disease that is devastating bat populations in the eastern US. It is caused by the fungus *Pseudogymnoascus destructans* (Pd), which colonizes the bat's skin during hibernation. In 2019, Montana Fish, Wildlife and Parks (MFWP) designed a plan to address the question of how the invasion and spread of WNS might affect the occupancy and activity (as an index of abundance) of bats across Montana. This project involves (1) surveillance for Pd and WNS and (2) long-term acoustic monitoring, compatible with the North American Bat Program. Understanding the distribution and impacts of WNS on Montana's bat populations will directly inform decisions about how aggressively Montana pursues bat management and conservation strategies—whether it be treatments specific to WNS, ecological approaches towards bolstering the health of our existing populations to improve their survival in the face of WNS, additional public outreach and education, or how we structure management to conserve habitat and mitigate other sources of mortality such as that from wind development. In 2020, the fungus that causes WNS was detected in eastern Montana and the first year of acoustic monitoring was completed with the placement of detectors at 87 sites across the state. Preliminary results indicate success of our methods and the need for continued effort. MFWP is looking for partners and volunteers to assist with the collection of bat guano at spring roost sites for disease surveillance in April and May as well as help with acoustic monitoring in June and July.

IMBCR Improves Assessment Accuracy of Habitat Treatment Effects on Songbird Communities through Capacity to Address Imperfect Detection

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The small spatial scales and broad objectives of many habitat treatments warrant use of community metrics such as species richness, rank and dispersion to assess outcomes. Assessment of songbird communities, often a focus of monitoring due to broad knowledge of species-habitat relationships and established monitoring strategies, can be hampered by imperfect detection of species occurrence and relative abundance. We sought to understand whether and how adopting the protocol of a broader bird monitoring program, IMBCR (Integrated Monitoring of Bird Conservation Regions), could aid in addressing the effects of imperfect detection on the accuracy of different of community metrics. We addressed these questions using analysis of IMBCR data across six common land use types in Montana, and across a range of spatial scales representing the variety of sizes of habitat treatments commonly implemented. We found that leveraging the state-wide IMBCR monitoring dataset significantly improved the accuracy of community assessment by allowing us to correct for imperfect detection (otherwise impossible) at moderate to larger spatial scales. Additionally, we found that community dynamics at small spatial scales were sufficiently variable that correction for imperfect detection was less effective than increasing the spatial scale in improving assessment accuracy. The effect of imperfect detection of species on the accuracy of community metrics is best addressed through adjustments to survey protocol, and we provide insight in into how this differs across communities.

**Long-term Assessment of the Change in Attitudes Towards and Knowledge of Black-Footed Ferrets and Black-Tailed Prairie Dogs in Montana

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The human component in endangered species conservation has the potential to significantly limit the ability to achieve recovery of these species globally. Across the Great Plains there have been significant declines in several grassland obligate species, including black-tailed prairie dogs (*Cynomys ludovicianus*) and the Critically Endangered black-footed ferret (Mustela nigripes). Social surveys conducted in Montana, USA 27 years ago immediately prior to the reintroduction of black-footed ferrets described widely differing attitudes and knowledge among different stakeholder groups - with most local and state residents being opposed to conservation and recovery of this keystone species and endangered carnivore. We conducted a mail survey replicating the methods of a 1993 study to assess current attitudes and knowledge towards prairie dogs and black-footed ferrets among five stakeholder groups (local and statewide ranchers, urban and local residents, and members of conservation organizations). Our results demonstrate that despite concerted outreach efforts and a general rise in knowledge about black-footed ferrets and prairie dogs across stakeholder groups, similar differences in attitudes persisted among stakeholder groups over time, where local stakeholders adjacent to recovery sites maintained most negative attitudes. We also observed that local stakeholders demonstrated a significantly shorter (< 1 0 years) threshold for giving up on restoring an endangered species should recovery goals not be met. Given the reliance on local public support for conserving these species, and other endangered species globally, our findings highlight the importance of continually reassessing stakeholder attitudes and knowledge over time to identify future opportunities and hurdles to endangered species restoration.