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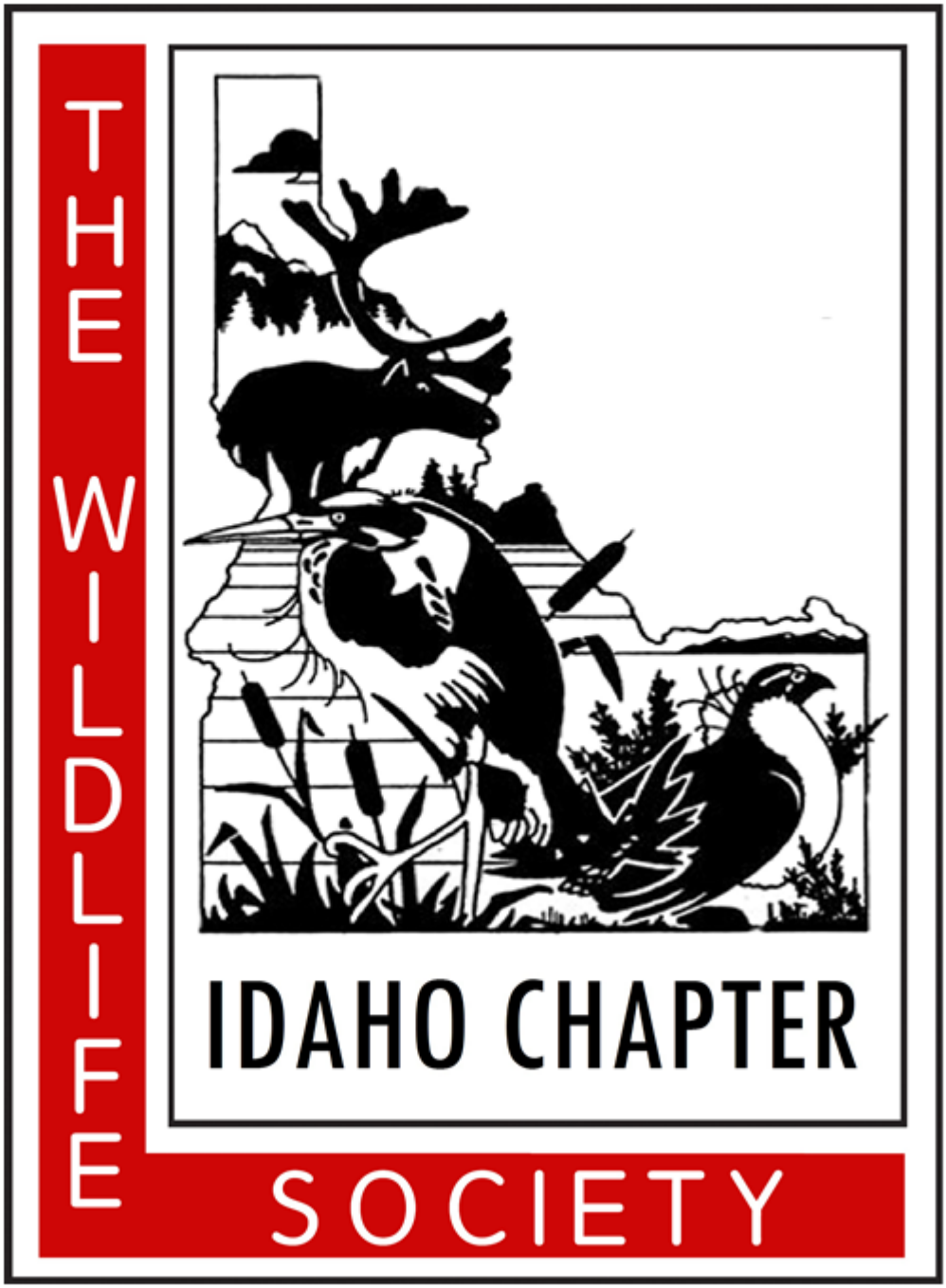

ABSTRACTS

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Andrews, Kimberly, J. Adams, D. Gour, LISETTE WAITS, University of Idaho, Moscow ID 83844. F. Cassirer, H. Miyasaki, N. Borg, Idaho Fish and Game. **USING HISTORIC SPECIMENS TO PROVIDE INSIGHT INTO NATIVE BIGHORN SHEEP GENETIC DIVERSITY AND CONNECTIVITY IN IDAHO.**

Bighorn sheep (*Ovis canadensis*) have experienced severe population declines and population extirpations across the western US. One region where bighorn sheep were not extirpated is the Salmon River Drainage of Idaho. These native populations are a highly valuable and irreplaceable genetic and ecological resource. The goal of this study was to evaluate genetic diversity and connectivity among bighorn sheep in this region using a combination of current and historic specimens. Specifically, we addressed 4 questions 1) What are the levels of genetic diversity and population connectivity for native Idaho bighorn sheep? 2) Are Population Management Units (PMUs) genetically distinct? 3) What were historic levels of genetic diversity in native Idaho bighorn sheep? 4) How has diversity changed over time? We obtained 350 current samples from 5 PMUs, 43 historic samples (1989) from the Middle Main Salmon (MMS) and 34 historic samples (1923-1985) from Lower Salmon (LS) and Middle Fork (MF) using horn shavings from the Carrey Collection. We genotyped 15 microsatellite loci, eleven neutral and four adaptive. We observed the highest levels of genetic diversity in the historic samples from the Carrey Collection and from current samples in the core of the range. The Carrey Collection samples also had a much larger number of unique alleles (13) compared to the historic specimens from MMS (0) and current samples (3). Our connectivity and gene flow analyses indicated that PMUs were genetically distinct, but there was evidence for gene flow between PMUs. We found evidence for higher historic connectivity between the LS and MF PMUs compared to current samples from these regions. This is the first study in bighorn sheep to evaluate changes in genetic diversity over time using historic specimens and demonstrates that unique alleles and genetic diversity have been lost over time which has implications for fitness and adaptive capacity.

AUSBAND, DAVID E. Idaho Department of Fish and Game, 2885 W. Kathleen, Coeur d' Alene, Idaho 83815. **TEN YEARS AFTER WOLF HARVEST: WHAT DO WE KNOW?**

Harvest of gray wolves (*Canis lupus*) began in in Idaho almost 10 years ago. Theories and untested hypotheses abounded about how harvest might affect gray wolves. Using a long-term genetic dataset as well as harvest information we now better understand how hunting and trapping affects wolves. We used harvest data to examine the mechanics of wolf harvest throughout Idaho. For example, were there "safe havens", were pups more vulnerable to harvest, and were few wolves harvested via rifle. We also used noninvasive genetic sampling and 18 microsatellite loci to construct group pedigrees and estimate pup survival for wolves subjected to harvest. We hypothesized that harvest reduces pup survival because of 1) reduced group size, 2) increased breeder turnover and/or 3) reduced number of female helpers. Alternatively, harvest

may increase pup survival possibly due to increased per capita food availability or it could be compensatory with other forms of mortality. Wolf harvest occurs virtually everywhere in Idaho, pups are not more vulnerable to harvest than adults, and most wolves are harvested via rifle during the general big-game season. Harvest also appeared to be additive because it reduced both pup survival and group size. In addition to harvest, turnover of breeding males and the presence of older, nonbreeding males also reduced pup survival. Large groups and breeder stability increased pup survival when there was harvest, however. Harvest did not increase the frequency of breeder turnover. Wolf harvest can be an effective tool for managing wolf population size in Idaho. Inferences about the effect of harvest on recruitment requires knowledge of harvest rate of young as well as the indirect effects associated with changes in group size and composition as we show.

BERGEN, SCOTT, Dave Leptich, and Mark Hurley. Idaho Dept. of Fish and Game.

IDENTIFYING PHRAGMITES USING SATELLITE IMAGERY AND VALIDATION USING UNMANNED AERIAL SYSTEMS IN THE LOWER COEUR d'ALENE RIVER BASIN.

Phragmites australis (elephant grass) is considered an invasive species capable of displacing endemic fauna and wildlife from wetlands across the globe. In a pilot project, the distribution and abundance of *Phragmites* dominated habitats were estimates and identified using OLI (Landsat 8) imagery collected for the Coeur d'Alene Lower River Basin in northern Idaho (~10,500ha). OLI imagery was processed to a 15m resolution using pan-sharpening techniques for light wavelengths within the panchromatic band (0.500–0.680µm, bands 2-4) or where resampled to 15m without any spectral reflectance adjustment (bands 1, 5-7). These bands plus the panchromatic were used in a supervised maximum likelihood classification with the primary objective of identifying *Phragmites* and a secondary objective of identifying native *Typha spp.* (cattail). Field locations for species were provided and used to create and develop spectral signature files for these habitat types. We validated these estimates by randomly selecting 30 validation survey points, where we collected high resolution imagery (4.1cm) from an UAS deploying a 5 band multispectral sensor (Mecasense™). The UAS image composites were used to manually identify prevalent wetland species and habitats (e.g. heads up digitizing). Satellite image based classification performed well with an overall accuracy of 74%. We found that OLI imagery was better able to distinguish *Phragmites* more accurately relative to earlier Landsat satellites because of OLI's ultra-blue bands (0.435 - 0.451µm) abilities to identify submerged and semi-submerged habitat. Acquiring late-summer to early-autumn satellite images provide the most discrimination for *Phragmites*, presumably due to the development of prominent inflorescences of the target species as well as delayed photosynthetic senescence of *Phragmites*. Size class distributions and spatial statistics show that *Phragmites* is significantly clustered in its

distribution, with larger habitats (>10ha) being more prevalent where the species was initially introduced in 1972. The use of UAS to validate species presence was successful at fine scales (<10m^2) and also provides more ground location data from which future *Phragmites* and *Typha* studies may be improved. Management and restoration implications will be discussed.

BRANCO, PAOLA * and Ryan A. Long. Department of Fish and Wildlife Sciences, University of Idaho, Moscow, Idaho 83843. **THE ELEPHANTS OF GORONGOSA: AN INTEGRATED APPROACH TO CONSERVATION AND CONFLICT MITIGATION IN THE SHADOW OF WAR.**

The recovery of Gorongosa National Park's elephant population from decimation by war is an unparalleled conservation success story. Yet, a concomitant increase in crop-raiding by elephants along the boundaries of the park now threatens to undo restoration efforts. Our project is the first to analyze the frequency, severity and distribution of raiding events around Gorongosa, and to experimentally evaluate strategies for reducing crop damage. To quantify patterns of crop-raiding, we fitted twelve male elephants with satellite collars that were programmed to send us their location each 30 minutes for two years. The first year of elephant tracking data allowed us to identify 13 main crossing points used by elephants to access crops. We then tested three different strategies for deterring elephants from crossing to the community at those locations: beehive fences, chili fences, and a combination of both ("spicy beehive fence"). We assigned treatments, as well as four control fences, at random to each of the 13 crossing locations. In addition to using GPS collar data to quantify elephant responses to the fences, we trained two teams of local community members to work on the project. One team of ten enumerators collected over 1,500 reports on human-elephant conflict events before and after the mitigation trials, and another team of six monitors collected daily data on elephant movements where the fences were built. We also installed 24 camera traps around the fences to observe elephant behavior in proximity to each fence type. Preliminary analyses suggest that the use of bees, either alone or in combination with chilies, significantly reduced the incidence of crop-raiding forays outside of park boundaries, whereas chili fences alone were less effective. Results of our study will be used to develop a long-term management plan for mitigating human-elephant conflict at Gorongosa.

DELL'ISOLA, BILL. Teton Regional Land Trust, Driggs Idaho 83422. **TETON BASIN TRUMPETER SWAN RESTROATION PARTNERSHIP.**

The breeding range of the Tri-State flock of the Rocky Mountain Population (RMP) of Trumpeter Swans (*Cygnusbuccinator*) is roughly centered around Yellowstone National Park (YNP); an area that sheltered the last remaining nesting Trumpeter Swans in the contiguous United States in the early 20th century. Despite the recovery of RMP Trumpeter Swans, the viability of the Tri-State flock remains a conservation challenge. Teton Basin provides significant winter habitat for RMP Trumpeter Swans, and despite valuable winter habitat along the Teton River and extensive wetlands, highly functional habitat suitable for Trumpeter Swan breeding was limited in recent history due to loss of beaver, water diversion and land use change. Land conservation efforts including wetland restoration, enhancement and protection in Teton Basin led by Teton Regional Land Trust (TRLT) since 1990 has facilitated the possible return of nesting Trumpeter Swans in Teton Basin. Trumpeter Swan nesting goals defined in the 2008 Pacific Flyway Management Plan, the strategic location of Teton Basin, and increasing concern about possible extirpation of Trumpeter Swans in YNP, motivated project partners to begin an initiative to release captive bred Trumpeter Swans onto permanently conserved wetlands in Teton Basin. A Teton Basin Trumpeter Swan Breeding Habitat Suitability Assessment was completed and formally evaluated the suitability of Teton Basin wetlands for supporting nesting Trumpeter Swans. Project partners (TRLT, Idaho Department of Fish and Game (IDFG), United States Fish and Wildlife Service, Intermountain Aquatics, Northern Rockies Trumpeter Swan Stewards, Wyoming Wetlands Society, foundations, private donors, and others) began Trumpeter Swan releases in Teton basin in the summer of 2013, and have since released a total 10 cygnets sand 8 yearlings over a total of 4 releases. Project monitoring is led by TRLT and IDFG and focuses on; maintaining location records of released birds, maintaining optimal habitat management at breeding marshes and maintaining viable partner-landowner relationships. The Partnership plans to continue Trumpeter Swan releases in Teton Basin for at least the next 5 years.

DRAPER, DAVID*[1], Dave Draper[1], Vance McFarland[1], Emmanuel Reyes[1], Bryan Krouse[2], Dusty Perkins[3], Beth Waterbury[4], [1]College of Western Idaho, Nampa ID 83687. [2]Dept. of Geography, College of Western Idaho, Nampa, ID 83687. [3]Dept. of Life Sciences, College of Western Idaho, Nampa ID 83687. [4] Idaho Fish and Game, Salmon Region Wildlife Diversity Program, Salmon ID. **MONARCH BUTTERFLY HABITAT SUITABILITY IN WESTERN IDAHO.**

Monarch butterfly (*Danaus plexippus*) populations have experienced dramatic declines due to habitat loss and fragmentation in wintering and breeding ranges. Anthropogenic disturbances in breeding ranges have decreased populations of obligate host plants (*Asclepias spp.*). Little

information exists on western monarch breeding habitat suitability. Due to increased need to understand monarch habitat needs, and potential Endangered Species Act listing, this study aims to record distributions and relative abundance of monarchs in Southwest Idaho. We employed citizen science efforts and the ArcGIS Collector app to collect milkweed and monarch occurrences as well as habitat characteristics on publically managed lands within the Treasure Valley, Idaho. We characterized ecological and anthropogenic factors at used, successful and vacant monarch breeding habitats using field methods and geospatial analyses in ArcGIS. We conducted habitat suitability analyses using generalized linear mixed models and AIC model selection procedures to evaluate the importance of breeding site characteristics in predicting monarch reproductive success. Preliminary results from 2016 suggest that monarch butterfly breeding success is correlated with increasing proportional cover of introduced and native vegetation and modest shrub steppe habitat within 100m of occupied milkweed patches. Monarch migrant arrival and breeding phenology also varied considerably between 2016 and 2017. Here, we incorporate additional data collected in 2017, evaluating habitat suitability implications for monarch butterfly conservation and management.

DUDKO, JONATHAN E.,[1,2]* Peter S. Coates[1] & David J. Delehanty[2]. [1] U.S. Geological Survey, Western Ecological Research Center, Dixon, California, 95620; [2] Biological Sciences, Idaho State University, Pocatello, Idaho, 83209 **MOVEMENTS OF GREATER SAGE-GROUSE (*CENTROCERCUS UROPHASIANUS)* DURING INCUBATION RECESS.**

When nesting, individuals within avian species with uniparental incubation must balance care of eggs at the nest with self-maintenance away from the nest. Mode of departure to and from the nest, space use, and activity pattern while away from the nest are important to understanding nest success and nesting habitat needs. Such information is lacking largely as a result of the difficulty of acquiring quantifiable field data. We combined three technologies for avian tracking and monitoring, i.e. GPS data loggers, VHF transmitters, and DVR video-monitoring, to measure fine-scale movement patterns during daily incubation recesses by female greater sage-grouse (*Centrocercus urophasianus*; hereafter, sage-grouse), a species with uniparental incubation. Most (69.6%) sage-grouse recess activity was highly localized within a core recess area averaging 2.58 ± 0.64 ha and females remained within 242.3 ± 30.0 m from the nest during recesses (total recess areas were 11.06 ± 2.27 ha). Females normally flew from the immediate vicinity of the nest to start recesses and returned to the nest area by walking or flying. Sage-grouse sustain incubation by using habitat within hundreds of meters of the nest, including satisfying any water and food needs, but this area is greater than the area typically measured to characterize nesting habitat. Conspicuous sage-grouse movements at the start and end of recesses and consistent occupation of core recess areas point to a mechanism for newly abundant predators such as the common raven (*Corvus corax*) to detect and depredate sage-grouse nests. Our methods readily can be applied to other avian species of scientific interest and conservation concern.

EVANS MACK, DIANE[1], Idaho Department of Fish and Game, McCall, ID 83638. Jeffrey Lewis[2], Robert Inman[3], Zack Walker[4], Bob Lanka[5], Justin Gude[3], Rex Sallabanks[6], John Vore[3], Robert Long[7], Stacy Courville[8], Michael Schwartz[9], Rick Kahn[10], Scott Jackson[11], Paul Lukacs[12], Jake Ivan[13]. [1]Idaho Department of Fish and Game, McCall, ID 83638; [2]Washington Department of Fish and Wildlife, Olympia, WA 98501; [3]Montana Fish, Wildlife, and Parks, Helena, MT 59620; [4]Wyoming Game and Fish Department, Lander, WY 82520; [5]Wyoming Game and Fish Department, Cheyenne, WY 82006; [6]Idaho Department of Fish and Game, Boise, ID 83707; [7]Woodland Park Zoo, Seattle, WA 98103; [8]Confederated Salish and Kootenai Tribes, Pablo, MT 59855; [9]Rocky Mountain Research Station, Missoula, MT 59801; [10]National Park Service, Fort Collins, CO 80525; [11]United States Forest Service, Missoula, MT 59804; [12]University of Montana, Missoula, MT 59812; [13]Colorado Parks and Wildlife, Fort Collins, CO 80526. **ESTABLISHING A CONTEMPORARY BASELINE OF WOLVERINE DISTRIBUTION AND GENETICS ACROSS 4 WESTERN STATES.**

The southernmost extant population of wolverines (Gulo gulo) in North America occurs in small, semi-isolated subpopulations in the Rocky Mountains of Montana, Idaho, and northwest Wyoming; and the north Cascade Range of Washington. Maintaining the wolverine metapopulation across this multi-state area is critical for ensuring wolverine persistence over time. We established a coordinated 4-state camera survey to obtain baseline information on occupancy and genetics of wolverines. During winters 2015–16 and 2016–17 we sampled 185 locations from a sampling frame of 633 grid cells and detected wolverines at 59 of the sampled cells. Of the DNA samples with positive results, more females were detected than males. We analyzed wolverine photo data using both non-spatial and spatial occupancy estimation methods. From non-spatial models, the 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 baited and revisited multiple times vs. sites that were scented only and visited less frequently. Average estimated probability of wolverine occupancy during our study was 0.42 (95% CI 0.29–0.55) suggesting that wolverines used nearly half of all sites during the study period. Proportion of predicted habitat in the cell was weakly associated with occupancy. Based on this occupancy estimate, the expected number of cells used by wolverines during the survey period was 208 (95% CI=169–249). From spatial models, wolverine occupancy probability varied across the region, with highest probability of occupancy 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 or habitat due to climate or anthropogenic changes.

FELTS, BRANDI[1], Daniel P. Walsh[2], E. Frances Cassirer1, Thomas E. Besser[3], and Jonathan A. Jenks[4]. [1]Idaho Department of Game and Fish, Lewiston, ID, USA 83501. [2]United States Geological Survey National Wildlife Health Center, Madison, WI, USA 53711. [3]Washington State University College of Veterinary Medicine, Pullman, WA, USA 99163. [4]South Dakota State University, Brookings, SD, USA 57007. **THE HAZARDS OF DISEASE: STRAIN-SPECIFIC CONSEQUENCES OF MYCOPLASMA OVIPNEUMONIA BIGHORN SHEEP EPIDEMICS.**

Bighorn sheep (*Ovis canadensis*) managers continually face dynamic challenges associated with population-limiting bronchopneumonia epizootics transmitted by domestic Caprinae. Although the etiology of pneumonia is not completely understood, we consider *Mycoplasma ovipneumoniae* (*M. ovi*) to be a primary pathogen responsible for bighorn sheep respiratory disease. Individuals recovered from initial *M. ovi* disease outbreaks become carriers of the *M. ovi* strain type encountered, and these strains are usually unique in independent outbreaks. Our objectives are to present information resulting from *M. ovi* strain cross-transmission in captive bighorn sheep. Unique *M. ovi* strains detected were 393 (Black Butte herd), 398 (Badlands and Rapid Creek herds), 400 (Snowstorm herd), and 404 (Asotin, Lostine, and Sheep Mountain herds). By July 2015, a *M. ovi* 400 strain spread across all populations within the South Dakota State University Captive Wildlife Research Facility. Serial samples were collected every 4-6 weeks and we documented exposure to the 400 *M. ovi* strain. Of these, 84% of sheep, at some point, actively shed 400 strain bacteria, which contributed to > 35% all-age-adult mortality. Within our herd, we compared pneumonia-related lamb mortality prior to the spread of the 400 strain (2014) versus mortality post 400 strain spread (2015). Mortality increased nearly two-fold after the spread of the pathogen with rates of 40% and 81%, respectively. To examine infection rates among populations, we estimated apparent *M. ovi* prevalence, which ranged from 0.19 to 0.83. We used event-time analyses to retrospectively model lamb and adult survival and determine force-of-infection of the 400 strain, and examined factors influencing the virulence of *M. ovi* strain types. By effectively modeling the response of populations to a novel *M. ovi* strain challenge, we aim to provide insight into the management of *M. ovi* cross-strain transmissions within and among wild bighorn sheep populations.

GILLETTE, GIFFORD. Idaho State University, Pocatello, Idaho 83201. **COLUMBIAN SHARP-TAILED GROUSE AS AN INDICATOR SPECIES: IS THE PROCESS OF IMPLEMENTING CRP-SAFE COMPENSATING FOR ENROLLMENT DECLINE?**

Approximately 28% of wildlife habitat available via the Conservation Reserve Program (CRP) has been lost in Idaho since 2013. Of remaining lands enrolled in CRP, 41% is being improved via the State Acres For Wildlife Enhancement (SAFE) subprogram of CRP which seeks to establish native grasses and forbs. We provide empirical evidence the CRP-SAFE subprogram

increases plant diversity in the form of native grasses and forbs. This vegetation reintroduction in CRP lands strengthens and reestablishes ecological processes that allowed wildlife species to occur in southern and eastern Idaho. Furthermore, demographics from 2011 to 2013 for Columbian sharp-tailed grouse (CSTG) occupying the same lands in this study but previously enrolled in general CRP indicated populations were likely to be declining. In our study from 2016 to 2017 we estimated CSTG occupying CRP-SAFE lands were stable. We attribute current population stability in the CSTG population occupying CRP-SAFE to the establishment of native grasses and forbs in these landscapes. Other factors such as climatic conditions could also influence differences in demographics, however, CSTG occupying shrub-steppe from 2011 to 2013 and from 2016 to 2017 were both estimated to be stable. We describe procedural practices for establishing CRP-SAFE plantings among 5 Idaho counties during mechanical seedbed preparation, chemical seedbed preparation, post-seeding practices, and seed mix design. Mechanical seedbed preparation typically occurred more than once and disking was the most common practice over harrowing and plowing. Chemical treatment to kill existing vegetation occurred a little over half the time CRP-SAFE plantings occurred. Clipping, or mowing, was the most common post-seeding management practice to reduce seeds dispersed by invasive annual plants. Twelve seed companies and 32 seed mixtures were used to seed 57 CRP-SAFE tracts. Mechanical and chemical treatment positively influenced the establishment of forb canopy cover - methods land managers control when seeding grasslands.

GILLETTE, GIFFORD. Native Earth, Rupert, Idaho 83350. **OPPORTUNITIES TO RESTORE WILDLIFE HABITAT.**

A fundamental component in the wildlife profession and wildlife science is the vegetation community. The importance of habitat cannot be understated in Idaho - the state with the fastest human population growth in the nation. Habitat loss and degradation is inevitable attrition independent of future population growth. A potential opportunity to strengthen wildlife habitat is simply doing a better job of growing native plants in natural landscapes. Despite being a common target for environmental concerns including the loss of wildlife habitat, commodity crop agriculture is the lodestar for plant growth and plant health. The amount of plants providing food in North America tripled from 1940 to 1990 and was achieved by using less land not more. There are multiple methods in commodity crop agriculture that may apply to growing native plants in natural landscapes. Providing plants with the nutrients required to survive and reproduce is an obvious approach that has been fundamental to supplying a population of 7.5 billion. Growing enough food is no longer the concern for fighting hunger. Providing plants with nutrients can include coating native seeds with high efficiency macro or micro nutrients and is not limited to synthetic fertilizer sources. Controlling annual invasive plants that compete with native plants for nutrients and displace them is another opportunity to help grow plants that are beneficial for wildlife. Too often, modern technologies for controlling these species are not used

when wildlife habitat is being restored; specifically, the use of adjuvants or non-ionic surfactants which increase the penetration, coverage, and overall effectiveness of herbicide. Lastly, inputs to the soil can amend what is available to plants and increase plant establishment, vigor, and health. Soils following fires are often referred to as hydrophobic which inhibits seed germination. Opportunities abound for applying commodity crop agriculture principles to restoring wildlife habitat.

HARJU, SETH. Heron Ecological, LLC, Kingston, Idaho 83839. **THE FAMOUS P-VALUE: A REVIEW OF WHIT IT IS AND IS NOT.**

Among non-statisticians, the p-value is probably the most widely recognized tool in the statistical toolbox. In practice, its common use has resulted in the fact that, like any tool, it can be wielded inappropriately with drastic results. Good research can remain unpublished and bad research can become dogma, both outcomes as a consequence of that small number. This talk explains what a p-value means and what it does not. A p-value does represent the frequency with which we can expect our results given our specified statistical model. A p-value does not represent the probability that a hypothesis is true, and it neither represents the importance of a finding nor the magnitude of an effect. A p-value cannot inform us when either a model is misspecified or the data have major structural problems. P-values and frequentist confidence intervals are intertwined and both are often misinterpreted as probabilistic metrics. However, p-values can be a useful tool to interpret our findings in conjunction with other information (e.g., confidence intervals, likelihood ratios). Non-p-value-reliant methods also exist. A solid understanding of p-values is crucial both for researchers and for those who rely on research results to ensure that inference and application are based on sound statistical science.

HEINEMEYER, KIMBERLY[1], John Squires[2], Mark Hebblewhite[3], Julia Smith[1], Joe Holbrook[2], Jeffrey Copeland[2] current affiliation: The Wolverine Foundation, Tetonia, ID 83452. [1]Round River Conservation Studies, Bozeman, MT. 59715. [2]Rocky Mountain Research Station, United States Forest Service, Missoula, MT 59802. [3]Wildlife Biology Program, Department of Ecosystem and Conservation Sciences, College of Forestry and Conservation, University of Montana, Missoula, MT, 59812. **WOLVERINE RESPONSES TO WINTER RECREATION: EFFECTS OF RECREATION TYPE AND INTENSITY ON HABITAT USE.**

Outdoor recreation provides opportunities for people to connect to nature, and is both a critical economic driver and part of the cultural fabric of some rural communities. Outdoor recreation is also increasingly recognized to have potentially important impacts on nature and wildlife, and we need to understand these potential effects. Technological advancements in over-snow equipment including ‘powder snowmobiles’ and lightweight backcountry ski gear provide opportunity for backcountry enthusiasts to access previously remote landscapes for winter recreation activities.

Wolverines may be vulnerable to direct and indirect impacts of backcountry winter recreation, as they remain active through the winter, naturally occur at low densities, have low reproductive rates, and enter reproductive dens within deep snowpack during the winter recreation season. Over 6 winters (2010-2015), four study areas, we GPS collared 24 individual wolverines exposed to a diversity of winter recreation activities within their home ranges in Idaho, Wyoming and Montana. We simultaneously monitored and sampled winter recreation, collecting nearly 6,000 GPS tracks from backcountry winter recreationists, with additional information collected through trail use counts and aerial-based recreation surveys. This combination of data allowed us to create maps of backcountry winter recreation portraying the extent and relative intensity of motorized recreation and non-motorized recreation within wolverine home ranges, and we found that winter recreation extent and relative intensity varies widely across individual home ranges. Using data for 18 animals (25 animal-years, >53,000 locations), we modelled sex-based habitat selection within home ranges using resource selection functions. We measured habitat selection responses of wolverines to linear (road-based) recreation and dispersed (off-road) motorized and non-motorized winter recreation. Wolverines exhibit functional responses to winter recreation, with avoidance increasing as relative intensity increases across home ranges. We provide the results from these analyses, and discuss them within the context of the large landscapes used and required by wolverines.

HELMSTETTER, NOLAN A.* [1], C. J. Conway[2], and A. R. Goldberg[1]. [1]University of Idaho, College of Natural Resources, Idaho Cooperative Fish and Wildlife Research Unit, [2]United States Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit 975 W. 6th St., Moscow, Idaho 83843. **A NEW HABITAT MODEL FOR NORTHERN IDAHO GROUND SQUIRRELS.**

Habitat models play a crucial role in the conservation and management of threatened and endangered species. Habitat models aid in identifying areas within a species' range that could benefit from protection and restoration, allow for more efficient monitoring, and help determine how land use affects population persistence. Northern Idaho ground squirrels (NIDGS) are a federally threatened species endemic to only two counties in Idaho. We used MaxEnt to create a new inductive habitat model for NIDGS based on locations that were occupied by squirrels during 2011 – 2017. We created a novel GIS spatial data layer for soil structure throughout the species range and included this variable into the habitat model, as well as numerous other environmental spatial data layers thought to be associated with NIDGS habitat. We used model building and model selection processes to compare candidate models, remove environmental variables with high collinearity, and create a final model for identifying high-quality NIDGS habitat throughout their historical range. A new NIDGS habitat model will help inform current NIDGS management and restoration efforts.

HORNE, JON[1], Mark Hurley[2], Jennifer Struthers[3], Kayte Groth[1]. [1]Idaho Department of Fish and Game, Lewiston, Idaho, 83501. [2]Idaho Department of Fish and Game, Boise 83712, Idaho, 83686. [3]Idaho Department of Fish and Game, Nampa, Idaho, 83686. **HOW ARE THE WOLVES DOING IN IDAHO? AN INTEGRATED POPULATION MODEL TO THE RESCUE**.

Monitoring wolf populations through time is important for determining population viability and evaluating the effects of management actions. It is also critical information for understanding the effect that wolf predation has on prey species. As part of a larger study seeking to understand ecological drivers of elk survival in Idaho, we needed a spatially and temporally explicit estimate of wolf abundance in areas where we had monitored elk survival. However, this information proved to be extremely elusive due to sporadic pack counts through time coupled with the challenges of keeping radio-collars on a hunted population of wolves. We developed an integrated population model (IMP) to reconstruct pack abundances through time in Idaho. From 2005 - 2016, we monitored 209 wolves with GPS collars and 121 wolf packs across the state. We combined information from GPS-collared individuals with pack counts to model pack-specific abundance on a monthly basis via the IPM. As part of the IPM we obtained estimates of dispersal, harvest, and mortality other than harvest. By leveraging information from both data sources (GPS collars and pack counts) we were able to estimate changes in pack abundance through time as well as other important parameters for which we have no specific information (e.g., recruitment, observation probability). Our results will be used to provide managers a better understanding of changes in the wolf population through time as well as provide a way to measure predation risk and its influence on elk survival.

HORNE, JON[1], Mark Hurley[2], Scott Bergen[3], Kayte Groth[1]. [1]Idaho Department of Fish and Game, Lewiston, Idaho, 83501. [2]Idaho Department of Fish and Game, Boise 83712, Idaho Department of Fish and Game, Pocatello ID 83204. **ECOLOGICAL DRIVERS OF ELK SURVIVAL IN IDAHO**.

Effective management of elk populations is facilitated by an understanding of the factors that influence elk survival. From 2005 - 2016, we monitored elk across the state of Idaho for mortality and often times cause-specific mortality. We compiled known-fate survival data from ~2000 radio-collared elk (1273 adult cows and 834 6-month-old calves). Statewide, lion and wolf predation were the main causes of mortality for cows (35% and 32%, respectively) and 6-month old calves (45% and 29%, respectively). Mortality rates were highly variable across elk populations and years. To examine factors potentially causing this variation, each elk was assigned to one of 29 populations based on its winter range. We then modeled risk of mortality as a function of winter severity, summer nutritional resources, and wolf abundance. We found that elk survival is inherently complex but by utilizing a data set encompassing substantial spatial and temporal variation, we were able to identify the main drivers of elk survival in Idaho.

HOLTHUIJZEN, ANTHONIE and G. Holmstead, Idaho Power Company, Boise, ID 83702. **PASSIVE RESTORATION OF RIPARIAN HABITAT AT A SMALL, PERENNIAL MOUNTAIN STREAM.**

In 2005, Idaho Power Company (IPC) created the Daly Creek Habitat Management Area (HMA) with purchase of the 10,212-acre Daly Creek Ranch in southeastern Oregon as partial mitigation for the relicensing of the Hells Canyon Hydroelectric Complex. Livestock grazing, which largely ceased in 2007, was the dominant land-use over the past 120 years. Conversion from flood- to sprinkler-irrigation and reducing irrigated farmland significantly reduced water use. Here, we report on changes along Daly Creek in woody riparian vegetation, stream shade and instream water temperature between 2007 and 2017. Stream shade was determined at 26 monitoring sites using aerial imagery in 2005, 2009, 2013, and 2017. Herbaceous ground cover and woody vegetation stem density and cover were measured at14 monitoring sites in 2007, 2011, 2014, and 2017. Data at 2 permanent stream gauges and 7 temperature sensors (Hobos) have been collected since 2009 and 2007, respectively. Beaver dams were inventoried yearly since 2009. Between 2007 and 2017, bare ground decreased by 50%. In contrast, litter and grass cover about doubled between 2007 and 2014, but then declined in 2017. Woody cover more than doubled between 2007 and 2014, but declined in 2017. Woody stem density increased by 73%, stream shade increased from 8 to 39% and the number of beaver dams doubled between 2009 and 2017. August base flows doubled between 2011 and 2017 and maximum daily water temperatures during the warmest summer days declined 2 ^{0}C. Filling of the incised river bed will reconnect the floodplain, expand riparian vegetation and likely result in a stable, fully functional riparian system in another 10-20 years.

JACOBS, CAITLIN, and D. Ausband. Idaho Department of Fish and Game, Coeur d'Alene, Idaho 83815. **AN EVALUATION OF CAMERA TRAP PERFORMANCE - WHAT ARE YOU MISSING AND DOES DEPLOYMENT HEIGHT MATTER?**

The camera trap is a powerful non-invasive research tool that has a wide range of ecological applications and facilitates monitoring over large spatial and temporal scales. Although the use of camera traps for wildlife surveys is common and widespread, camera traps have limitations that researchers sometimes fail to recognize. To improve the reliability of camera trap studies and provide more knowledge on camera performance, we evaluated three aspects of camera traps that researchers should consider – missed detections, camera height, and false detections. We hypothesized that 1) missed detections would increase at temperatures > 30°C, 2) missed detections would increase as species size decreased, 3) missed detections would increase as the distance from the camera to the trail decreased, 4) low cameras (0.6 m) would have greater total detections of all species and of small species in particular compared to high cameras (3 m), 5) low cameras would have more false detections than high cameras, and 6) false detections would increase as temperature increased. We found that placing cameras high to deter theft and damage

does not influence detection rates. There are however, more false detections which can increase the time required for analysis. Perhaps most surprising is that cameras, even the same manufacturer and model deployed side by side, vary in their ability to reliably detect animals that pass by. These missed detections increase as species size decreases. We urge biologists to take camera trap performance into account and consider that detection probabilities are not always 1 inside a camera's detection zone. Variation in detection depends on target species, environmental conditions, and deployment methods. Camera traps have a wide range of ecological applications and understanding their limitations will help us avoid spurious conclusions and ultimately make more informed management and conservation decisions.

KENSEY, QUINN *[1], David Goltz[2], Jackson Davis[2], Rachael Snodgrass[2], David Leptich[2], and Stephen Hayes[1]. [1](Gonzaga University, Spokane, WA, 99258). [2]Idaho Fish and Game. **USING WOOD DUCK EGGSHELLS TO BIOMONITOR LEAD IN THE IDAHO PANHANDLE.**

Over 100 years of mining and smelting in Idaho's Coeur d'Alene River Basin (CDARB) has contaminated the surrounding environment with metals such as mercury, cadmium, and lead (Pb). An estimated 1,250,000 tons of Pb was released into the CDARB between 1884 and 1997. We investigated the effectiveness of using wood duck (*Aix sponsa*) eggshells to biomonitor environmental Pb by comparing CDARB and reference eggshell samples. Eggshells from migratory birds using nest boxes have potential to be an effective, noninvasive biomonitor because (1) metal accumulation in eggshells represents short-term exposure that occurred while nesting on the breeding grounds, (2) egg-laying hens excrete heavy metals by sequestering them in eggshells, and (3) sample collection can be done during nest box maintenance. We monitored 168 nest boxes in the Idaho Panhandle during June-July 2017, and collected 61 wood duck eggshell samples. We also collected 33 wetland sediment samples near nest boxes to estimate environmental Pb concentrations. We isolated 2 g samples of shell fragments from membranes and nest debris, then cleaned them with deionized water and acetone. Lead concentrations were estimated using inductively coupled plasma – mass spectrometry by Anatek Labs (Spokane). Preliminary analysis (n=44) indicates that CDARB eggshells contain 2.3 times more Pb than reference samples ($p=0.0018$, 2.29 mg/Kg vs 0.99 mg/Kg). We also observed a significant linear relationship between wetland and eggshell Pb concentration ($p=0.0005$). Furthermore, the only 3 reference nests with detectable (>0.501 mg/Kg) Pb levels had a mean concentration greater than the CDARB (3.41 mg/Kg), were clustered together, and adjacent to a reference wetland that contained the greatest amount of Pb observed at reference sites. Our results demonstrate the potential of wood duck eggshells to be an inexpensive and effective biomonitoring tool for Pb in wetland ecosystems.

KRISTOF, ANDREA[1,2]* and Bruce Dugger[1]. [1]Oregon State University, Department of Fisheries and Wildlife, Corvallis, OR 97331. [2]Camas National Wildlife Refuge, Hamer, Idaho 83425.
IMPROVING MANAGEMENT OF STOPOVER HABITAT FOR MIGRATORY WATERFOWL USING AN EMPIRICALLY DERIVED STATE-AND-TRANSITION MODEL.

The persistence of waterfowl species requires the conservation of the wetland ecosystems upon which they depend for all parts of their annual cycle. Intermountain West wetlands are naturally rare on the landscape and have endured over a century of destruction and modification. Those that remain are disproportionately important to wildlife. On a continental scale, these wetlands are significant for the stopover habitat that they provide to waterfowl of the Pacific flyway. Relatively little is known about the habitat needs of waterfowl during migration, in particular their use of submerged aquatic vegetation beds that provide valuable energy resources. In this study, we contributed to the development of a state-and-transition model to improve management of these stopover habitats by 1) empirically defining submerged aquatic vegetation communities that occur in the Intermountain West, and 2) describing the abiotic context associated with each vegetation community. We sampled the vegetation and abiotic conditions within 42 wetland units spanning 12 National Wildlife Refuges between 2015 and 2017. We used a hierarchical agglomerative cluster analysis in combination with an indicator species analysis to identify eight submerged aquatic vegetation communities. Each community was described in terms of typical abundant species, most frequently occurring species, and top indicator species. We used a non-metric multidimensional scaling ordination to evaluate the relative strength of each vegetation community's association with hydrological conditions and soil characteristics. This knowledge will expand our understanding of submerged aquatic vegetation communities and provide a basis for wetland management models that include objectives for submerged aquatic vegetation beds.

KROHNER, JESSICA and D. E. Ausband. Idaho Department of Fish and Game, Coeur d'Alene, Idaho, 83815. **CO-OCCURRENCE BETWEEN SYMPATRIC APEX PREDATORS ACROSS A DIVERSE LANDSCAPE.**

Coexistence between sympatric predators is achieved through a variety of mechanisms employed to reduce competitive interactions. Ours is the first study to examine fine-scale (i.e. camera trap) co-occurrence between all sympatric apex predators across a large and highly variable landscape, characterized by high levels of anthropogenic presence and harvest pressure. In the summer of 2016, we deployed 201 game cameras across more than 120,000 km^2 to examine spatiotemporal associations between four apex predator species found throughout Idaho USA: humans (*Homo sapiens*), wolves (*Canis lupus*), black bears (*Ursus americanus*), and cougars (*Puma concolor*). We hypothesized that detections of the dominant competitors in our system would be associated with reduced detections of their subordinate competitors (i.e. humans > wolves > black bears >

cougars), which proved true only when examining associations between human and wolf detections. We found a reciprocal positive association between black bear and cougar detections, suggesting that cougar kills may provide kleptoparisitism opportunities for other apex predators. We also tested daily temporal activity pattern differences, hypothesizing that subordinate competitors would avoid dominant competitors temporally, and found a strong significant temporal difference between wolf and black bear detections. In multipredator landscapes the degree of competition and ability for coexistence between apex predators is useful for understanding how such communities affect member species as well as the prey upon which they rely. Understanding the co-occurrence of apex predators in a system is not a simple measure of their relative dominance cascading from one level to the next.

MAKELA, PAUL. U.S. Bureau of Land Management, Idaho State Office Branch of Resources and Science, 1387 South Vinnell Way, Boise, ID 83709. **AN OVERVIEW OF THE SAGE-GROUSE HABITAT ASSESSMENT FRAMEWORK.**

In 2015 the U.S. Bureau of Land Management, in coordination with the Western Association of Fish and Wildlife Agencies, published the Sage-Grouse Habitat Assessment Framework-A Multiscale Assessment Tool, or "HAF" (BLM Technical Reference 6710-1; Stiver et al. 2015). Foundational to the HAF is its landscape vision, based on the four hierarchical orders, or scales, of species habitat selection described by Johnson (1980). The orders are scale- dependent, and each order is nested within the next larger order. For example, a sage-grouse nest is found in an area with adequate shrub and herbaceous cover and occurs within nesting habitat at the Site-Scale, which in turn lies within a home range at the Fine-Scale, encompassing all seasonal habitats for the local population, which in turn lies within a broader population or metapopulation area at the Mid-Scale, which in turn, is part of the species range or Broad-Scale. The Site, Fine, and Mid-scales each contain a suite of vegetation or anthropogenic indicators that collectively, and in conjunction with professional judgement, can be used to characterize these scales as suitable, marginal or unsuitable for sage-grouse. This presentation provides a brief summary of the genesis of the HAF and key components.

MALONEY, DUSTIN, and Steve Slater. HawkWatch International, Inc., 2240 South 900 East, Salt Lake City, UT 84016, USA. **QUANTIFYING EAGLE VEHICLE STRIKE RISK IN THE WEST.**

Roads represent a danger for both Bald Eagles (*Haliaeetus leucocephalus*) and Golden Eagles (*Aquila chrysaetos*) in the western U.S., primarily in relation to foraging on road-killed wildlife. Vehicle strike risk for eagles is generally greater during fall and winter months, when eagles move off breeding areas, live prey is less available and big game species move to lower elevations. We conducted the first year of a planned 4-year study of eagle activity and mortality

along roadways in central Utah and southeastern Oregon from 15 September 2016–13 February 2017. We performed repeated driving surveys to record carcasses and live eagles, walking and dog surveys of right-of-ways to detect additional carcasses, and placed camera traps on carcasses to quantify eagle use patterns. Three eagle mortalities were found during approximately 8,000 and 3,100 driving survey miles in Oregon and Utah, respectively, but walking and dog surveys of <5% of the combined study areas produced an additional 4 recent eagle carcasses. We found over 2.6 times as many mammal carcasses per road mile in Utah, likely responsible for the higher abundance of both live and dead eagles there. Considering both study areas, driving surveys recorded a relatively even mix of eagle species (54.0% Golden Eagle; 43.9% Bald Eagle) and documented 65 eagle-carcass associations (1.6 eagles/carcass) and 830 available carcasses. Camera traps placed opportunistically on roadside carcasses captured eagles at 29.1% of sites and gathered over 9,400 eagle pictures. This data will provide invaluable insight into eagle reactions to vehicles under varying conditions. In November 2017, we began our second year of fieldwork and have documented 8 eagle mortalities thus far. We are expanding our research efforts into Wyoming with various partners, and seek additional partners in Idaho to expand this critical conservation research.

MARTINEZ, VICTORIA*[1], Dave Draper[1], Beth Waterbury[2], Dusty Perkins[1]. [1]College of Western Idaho, Nampa ID [2], Idaho Fish and Game, Salmon Region Wildlife Diversity Program, Salmon ID. **CHARACTERIZATION OF Ophryocystis elektroscirrha (OE) PARASITE INFECTION IN WESTERN IDAHO MONARCH BUTTERFLIES (Danaus plexippus).**

Monarch butterfly (*Danaus plexippus*) populations in North America have undergone widespread declines since the mid-1990s. Declines appear to be the result of several apparent and entangled, factors including habitat loss and fragmentation, pesticides, intensified agricultural practices, climate-change and increases in parasitism. In light of increasing conservation concerns and prospective Endangered Species Act listing, researchers and conservationists have begun evaluating the potential impacts of parasites and parasitoids on monarch larval and adult survival and reproduction. One parasite known to influence monarch butterfly survival is *Ophryocystis elekrtoscirrha* (OE). This protozoan parasite infect them at varying levels throughout North America. OE spores are transmitted by adult monarchs and are ingested by larvae during feeding activities. OE spores reproduce in the larval digestive system and form on the abdomen of adult monarchs during the pupal stage. Monarchs with OE, emerge with smaller wingspans and a lower body mass than other adults making it harder for them to successfully migrate. We sought to characterize OE parasitism in Idaho to inform potential drivers of monarch health and population viability. We used non-invasive methods to test 195 [DP1] [VM2] monarchs for OE infection across three distinct generations from 8 breeding populations in the Snake River Basin of Idaho between June and October 2017. We estimated OE infection rates in monarchs and evaluated spatial and trends of infection status and severity. Here we present the results of our analyses and their implications for monarch conservation.

MATHEWS, STEVEN R.[1,2] *, P.S. Coates,[1,2] and D.J. Delehanty[1]. [1]Idaho State University, Pocatello, Idaho 83209. [2]. U.S. Geological Survey, Western Ecological Research Center, Dixon, California 95620. **FIELD TEST OF ARTIFICIAL INSEMINATION INTENDED TO INCREASE NEST INITIATION RATES OF TRANSLOCATED SHARP-TAILED GROUSE (*Tympanuchus phasianellus columbianus*).**

As part of a long term effort to restore Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus;* hereafter CSTG) to historic range in Nevada, we captured CSTG (*n* = 204) from source populations in SE Idaho and translocated them to an unoccupied range in NE Nevada from 2013-2017. In translocations of CSTG, and prairie grouse in general, nest-initiation at the release site by translocated females is generally low, hampering the establishment of a self-sustaining population. Consistent with previous CSTG translocations, nest-initiation rates of translocated females at our reintroduction site was low during the first year of the reintroduction (probability of nest initiation = 0.5). One reason for low nest initiation may be that translocated females lack mating opportunities within the release area. Translocated females are unfamiliar with the geographic and social environment of the release area and they may fail to locate breeding males in order to fertilize a clutch. We tested the efficacy of artificial insemination (AI) of female CSTG immediately preceding their release into Nevada. Our purpose was to ensure that a sample of females (*n* = 19) had spermatozoa prior to release. Following implementation of AI, the probability of nest-initiation at the release site increased to a high of 0.89 in 2015. To confirm or refute that observed increases in nest-initiation rates were due to AI rather than the result of an increasing population at the reintroduction site, we employed genetic parentage analyses of eggshell membranes to assess the probable paternity of clutches laid by AI females. Here, we present genetic results regarding the efficacy of AI with translocated female CSTG in Nevada.

MEREMS, JENNIFER L * and R. A Long, College of Natural Resources, University of Idaho; 975 W 6th St, Moscow, ID 83844. **BEHAVIORAL PLASTICITY MODULATES THE INDIRECT EFFECTS OF INTERFERENCE COMPETITION ON HERBIVORE FITNESS.**

Interference competition plays a fundamental role in structuring animal communities by producing strong patterns of avoidance or displacement that can dictate species' distributions, patterns of resource exploitation, and relative abundances. Despite the ubiquity of interference competition in nature, however, fitness consequences of sublethal competitive interactions remain poorly understood. Similarly, the degree to which individuals of a subordinate species are able to mitigate negative consequences of interference competition by adjusting their behavior along a continuum of risk prone to risk averse has received almost no attention. In the presence of a competitor, subordinate species may be faced with a tradeoff between maximizing access to key resources and avoiding direct interactions with the competitor. Over the past several decades, mule deer (*Odocoileus hemionus*) populations have declined precipitously throughout

their historic range in western North America. At the same time, elk (*Cervus canadensis*) populations have remained stable or have increased. Accordingly, interference competition with elk has been hypothesized to be a leading cause of mule deer declines. We evaluated the effects of interference competition on mule deer at Starkey Experimental Forest and Range in northeastern Oregon. A nutritional landscape for spring and summer was created in 2016 and 2017. Location data for both species was collected to model use of the nutritional landscape. JEN doesn't know what to write here to make up results… she is a bad lier. Our results suggest that interference competition plays a significant role in selection of the nutritional landscape by mule deer, ultimately effecting their body condition entering winter.

NICHOLSON, JEREMY. Idaho Fish and Game, Island Park, Idaho, 83429. **GRIZZLY BEAR RESEARCH AND MANAGEMENT IN THE UPPER SNAKE REGION.**

Idaho Fish and Game (IDFG) personnel spend significant time each year on the research and management of grizzly bears. We radio collar grizzly bears and perform observation flights to spot females with young. Research trapping is conducted in July and August. Bears are captured in culvert traps and foot snares using natural bait and fitted with GPS or VHF collars. By monitoring radio-collared bears we document their use of habitat, movements, causes of mortality, reproductive success, and the location and timing of den entry and emergence. The annual grizzly bear population estimate is derived from the number of unduplicated females with cubs of the year observed in the Yellowstone Ecosystem. Observation data comes from a variety of sources, including aerial surveys conducted in fixed-wing aircraft. Aerial surveys are conducted in 4 flight observation units in June and repeated in July. At the same time we are capturing bears and performing observation flights, we are handling human-bear conflicts. We deal with bears that obtain human attractants, cause property damage, kill livestock, and are involved in aggressive human encounters. We try to be proactive and reduce problems through outreach and education. The IDFG maintains a website that includes information about bear biology and staying safe in bear country and provides information on their Facebook page and in local newspapers regarding bear activity. We give formal presentations, provide workshops, educate hunters and fisherman, and tour the region with our bear education trailer, reaching thousands of locals and visitors. We perform site visits to verify bear activity, evaluate the situation, and provide guidance on ways to alleviate the problem. As a last resort, we capture and relocate or remove bears that are food conditioned or pose a threat to human property or safety.

PETERSON, LOGAN B., and Ryan N. Walker. Idaho Department of Fish and Game, 4279 Commerce Circle, Idaho Falls, Idaho 83401. **WEED SUPPRESSIVE BACTERIA AT TEX CREEK WILDLIFE MANAGEMENT AREA: FIRST YEAR HIGHLIGHTS OF A MULTI-YEAR TRIAL.**

In August 2016, the Henry's Creek fire burned approximately 66% of Tex Creek Wildlife Management Area in eastern Idaho. One of our primary fire rehabilitation goals was to limit the spread of noxious weeds, such as cheatgrass (*Bromus tectorum*), following the fire as noxious weeds have limited recovery following other fires in the area and throughout the West. We applied a then-commercially available strain of weed suppressive bacteria to 6,800 acres of Tex Creek Wildlife Management Area in November 2016 to aid us in this goal. We established an application-based trial with 16 paired 1-acre plots to test the effects of weed suppressive bacteria along with other common fire rehabilitation techniques. We will present some preliminary findings and discuss highlights of the project along with considerations for managers on future fires.

POWELL, KATIE[1]. Brian Woodbridge[2], Gary Williams[2], Todd Lickfett[2] and Geoffrey Bedrosian[2]. [1]U.S. Fish and Wildlife Service, Boise, ID 83709. [2]U.S. Fish and Wildlife Service.

OVERVIEW OF USFWS WESTERN GOLDEN EAGLE TEAM'S RISK ASSESSMENT AND CONSERVATION PLANNING PROGRAM.

U.S. Fish and Wildlife Service Regions 1, 2, 6 and 8 established the Western Golden Eagle Team (WGET) in 2013 to proactively address energy-related conservation needs of Golden Eagles (*Aquila chrysaetos*) by developing landscape-scale conservation strategies. Our conservation strategies are informed by: 1) predictive models of the relative density of exposure (eagle presence) of Golden Eagles throughout the western U.S. during three overlapping life history stages; breeding, dispersal and migration, and overwintering; 2) spatially explicit assessments of hazards including electrocution, contaminants, and collisions with vehicles; and 3) information resources to support management of Golden Eagles and their prey. Integration of our exposure models with mapping or predictive models of hazards such as proposed wind development or electrocution on power distribution structures provides a proactive risk assessment and decision support framework for evaluating siting of renewable energy development as well as potential mitigation actions. Working in collaboration with scientists and managers from state and federal government, academic, Tribal and private organizations, WGET is developing a range of assessments and information resources intended to provide additional foundation for conservation strategies. Focusing on potential mitigation approaches, we are evaluating and modeling (for example) spatial aspects of eagle electrocution hazard and remediation, spatial attributes of Golden Eagle responses to disturbance, and the incidence and exposure routes of lead and anticoagulant rodenticides. In support of habitat-based conservation measures, we are working on extensive analyses of Golden Eagle diets, composition and variability of prey communities, and habitat management strategies for important prey species. Effective implementation of risk assessment and decision support tools, and conservation measures is an adaptive process. To evaluate and refine these products, WGET and partners will be reliant on feedback from practitioners, incorporation of new research, and targeted field surveys to fill data gaps.

ROBERTS, SHANE [1], Devin Englestead[2], and Eric Anderson[3]. [1]Idaho Department of Fish and Game, Idaho Falls, Idaho, 83401. [2]Bureau of Land Management, Idaho Falls, Idaho, 83401. [3]Utah Division of Wildlife Resources, Salt Lake City, Utah, 84114. **GREATER SAGE-GROUSE DEMOGRAPHICS AND USE OF MANAGED SAGEBRUSH HABITATS IN EASTERN IDAHO.**

This study is using hen sage-grouse monitored with GPS-PTT transmitters to better understand the relationship between sage-grouse demographics and habitat structure in the high-elevation sagebrush landscapes of eastern Idaho. At the 2017 ICTWS conference, we presented preliminary nest site selection and success results for three study sites in Eastern Idaho (Sand Creek, Lemhi Valley, Pahsimeroi Valley). During this talk, we will focus on nest site selection and success, brood site selection and success, and hen seasonal habitat selection data collected from sage-grouse reproducing on the Sand Creek desert and examine how those demographic and selection results relate to past sagebrush management activities (e.g., prescribed fire). The Sand Creek desert is a high-elevation, sage-steppe landscape northeast of Idaho Falls that generally produces exceptional mountain big sagebrush (*Artemisia tridentata* spp *vaseyana*) and antelope bitterbrush (*Purshia tridentata*) growth. We are using the sage-grouse data, coupled with vegetation data collected using the Habitat Assessment Framework (HAF) protocol at nests and random locations and remotely-sensed data, to model how habitat affects demographics and selection. We'll then relate those results to the habitat composition and structure found in managed sagebrush stands of varying age to provide management recommendations.

~~ROMERO, JOHN. Owyhee Air Research, Inc., 3305 Airport Rd., Nampa, ID 83687.~~ ~~**A DEMONSTRATION OF FIELD EXPERINCE DETECTING AND COUNTING WILDLIFE WITH HIGH RESOLUTION COLLED INFRARED AND HIGH DEFINITION DAYLIGHT VIDEO FROM AERIAL PLATFORMS.**~~

~~Since 2010, Owyhee Air Research, Inc. (OAR) has partnered with various agencies successfully researching wildlife with aerial infrared (AIR) across the US and Canada. In 2015, OAR began utilizing an advanced camera system developed by Wescam®.The new system integrates AIR with high definition daylight recording capabilities, laser rangefinders, and GIS computer functions. Mounted on a fixed wing aircraft, this new system has been used to successfully locate and count a variety of wildlife species. OAR has conducted AIR surveys for a variety of species in varied topography and vegetative types. The efficacy of using AIR to detect and census known and unknown sage grouse (*Centrocercus urophasianus*) and sharp-tailed grouse (*Tympanuchus phasianellus*) leks has now been well documented. Much has been learned about conducting AIR surveys for wildlife and the lessons learned from recent surveys will be discussed. In its current configuration, a fixed-wing aircraft - mounted advanced AIR system may have advantages over ground based and aerial visual surveys. Increased wildlife detectability, precisely defined survey~~

~~transects, greater spatial variation, night time observations, and little disturbance to wildlife in critical ranges and breeding habitat all contribute to survey quality and effectiveness. One of the biggest advantages is the safety of agency personnel. Recent technological advancements in AIR accompanied with high definition daylight recording capabilities and integrated GIS computer functions are becoming increasingly valuable tools for aerial wildlife surveys and enable acquisition of what may be otherwise unavailable data~~.

SCHREMPP, THOMAS V.[1,2], J. L. Rachlow[1], T. R. Johnson[3], L. A. Shipley[4], R. A. Long[1], J. L. Aycrigg[1], and M. A. Hurley[5]. [1]Department of Fish and Wildlife Sciences, University of Idaho, Moscow, Idaho 83844 USA; [2]Idaho Department of Fish and Game, Lewiston, Idaho 38501 USA; [3]Department of Statistical Science, University of Idaho, Moscow, Idaho 83844 USA; [4]School of the Environment, Washington State University, Pullman, Washington 99164 USA; [5]Idaho Department of Fish and Game, Boise, Idaho 83712 USA. **VARIATION IN THE NUTRITIONAL LANDSCAPE LINKS FOREST MANAGEMENT TO POPULATION PERFORMANCE OF MOOSE**

Forested lands in the western USA have undergone changes in management and condition that are resulting in a shift towards climax vegetation. These changes can influence the quality and quantity of forage for herbivores that rely on early-seral plants. To evaluate how management of forested landscapes might affect nutrition for Shiras moose (*A. a. shirasi*) at large spatial scales, we evaluated the effect of summer diet composition, forage availability and selection, and forage quality on population dynamics for moose across 21 game management units (GMUs) in northern Idaho. We identified 20 forage shrubs in the diets of moose, 11 of which comprised the bulk of the diets and were mostly consumed in proportion to their availability. Forage species varied markedly in both energy and protein. By adapting established field sampling methods and integrating them with recent advances in remote sensing analyses in a modeling framework, we predicted current and past (i.e., 1984) quantity of forage shrubs across northern Idaho. We also created indices of population trend and productivity for moose across GMUs. Predicted quantities of forage shrubs varied markedly across the study area with generally higher values in the north relative to the south. The quantity of forage shrubs was estimated to have declined over the past 30 years in about half of the GMUs, with the greatest declines predicted for high-energy forage species. Population trends were most strongly associated with the percent change in availability of moderate-energy forage, and population productivity was positively correlated with both the current quantity and the percent change in high-energy and high-protein forage shrubs. Our results demonstrated substantial spatiotemporal variability in forage quantity and quality that was correlated with indices of moose population performance, supporting our hypothesis that forage is likely affecting population dynamics for moose in northern Idaho.

SERVHEEN, GREGG. Idaho Department of Fish and Game, Boise, ID 83712. **A SUMMARY OF THE IDAHO CLIMATE SUMMIT, POST SUMMIT ACTIONS, WITH ATTENTION TO IMPLICATION FOR THE CHAPTER, PROFESIONAL BIOLOGISTS, WILDLIFE, AND WILDLIFE RECREATION IN IDAHO.**

Sponsored by the Idaho Chapter of the Wildlife Society and Idaho Chapter of the American Fisheries Society, the Idaho Climate Summit held on November 16-17, 2017 in Boise, Moscow, Pocatello, and Ashton had 575 registered participants including live streaming, 53 sponsors, 92 speakers, panelists and presentations, 27 exhibitors, and 82 volunteer facilitators and logistical supporters. A 12 person Planning Committee devised the Summit and its agenda, The Nature Conservancy acted as Summit contract administrator, and Warm Springs Consulting was hired to manage and implement the Summit. All three of Idaho's major universities provided venues and were major sponsors of the Summit. The Summit focused on how Idaho's economy and businesses are being affected by Idaho's changing climate and how organizations are responding to these changes. Summit themes and facilitated breakout sessions focused on: forests and wildfire; health and quality of life; recreation, fish and wildlife; agriculture and rangeland; and infrastructure and the built environment. The Idaho Climate website: www.idahoclimatesummit.com now provides attendees and others access to the recorded livestream video of the Summit, a survey to provide feedback on the Summit, and a diversity of resources related to climate and Idaho. An Idaho at a Glance: Climate Overview and a summary of feedback on the Climate Summit were produced by the University of Idaho McClure Center for Public Policy Research for the Summit. A summary of Summit outcomes as well as recommended strategies for moving ahead on climate-related actions in Idaho is discussed as well as implications for Idaho's fish and wildlife managers, professionals, and publics.

SHIPLEY, LISA A.[1], S. L. Berry[1], R. A. Long[2], and C. O. Loggers[3], [1]Washington State University, Pullman, WA 99164. [2] University of Idaho, Moscow, ID 83844. [3]Colville National Forest, U.S. Forest Service, Kettle Falls, WA 99141. **A COMPARISON OF NUTRITIONAL AND FORAGING ECOLOGY OF SYMPATRIC MULE AND WHITE-TAILED DEER.**

Over the last few decades, white-tailed deer populations have expanded their distribution in many areas along a north-south zone along the Rocky Mountains where they co-occur with mule deer. To better understand potential for competition and niche partitioning, we compared foraging behavior and nutrition of tractable mule and white-tailed deer in 21 ponderosa pine/Douglas fir stands in northeastern Washington that varied 10-fold in forage biomass. In each stand, we measured forage composition and biomass, recorded deer behavior, and determined harvesting rate and diet composition, selection, and nutritional quality. Although diets, intake and behavior were relatively similar overall, mule deer took larger bites and harvested food faster, whereas white-tailed deer traveled further while foraging and consumed more diverse diets that were slightly, but significantly, more nutritious. Diet composition when

foraging in the same stands was < 20% similar. These differences suggest a moderate degree of diet partitioning between the deer species arising from different fundamental dietary niches. Therefore, habitat management that affects the amount and species composition of forage might influence the performance of the deer species.

STEVENS, BRYAN[1], and Courtney Conway[2]. [1]Idaho Cooperative Fish and Wildlife Research Unit, Department of Fish and Wildlife Sciences, University of Idaho, Moscow, Idaho 83844. [2]U.S. Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, Idaho 83844. **DEVELOPING PREDICTIVE DISTRIBUTION MODELS FOR SECRETIVE MARSH BIRDS: OCCUPANCY AND SPATIAL MODELING TO FACILITATE HABITAT CONSERVATION.**

Models are commonly used for predicting species distributions and characterizing wildlife-habitat relationships. As such, distribution models play a pivotal role in prioritizing habitat management and conservation. Secretive marsh birds are a widely distributed species group whose statuses range from common and harvested to threatened and endangered. Many marsh bird populations have declined, thus identification of remaining areas with optimal habitat is helpful for management and land-use planning. Our objective was to develop optimally-predictive distribution models for 14 species of marsh birds in North America, and use these models to identify important areas for conservation of breeding habitats. We used data from field surveys conducted during a 14-year period (1999-2012) at > 8,000 sites across the U.S. to develop hierarchical occupancy models to characterize species distributions, and used Bayesian model selection to optimize model structures for prediction. We modeled occupancy as a function of wetland and land cover attributes measured at multiple spatial scales, and identified the optimally-predictive multi-scale model for each species. We used spatial analyses to translate these models into maps of predicted habitat suitability, allowing us to identify the most important habitats for each species. Lastly, we illustrate the integration of these tools to identify important areas for habitat conservation on military installations located across the continental U.S., and show that an aggregation of important areas occurs on a small number of sites located primarily in the southeastern U.S. This work provides a vital first step towards conserving the most valuable habitat for secretive marsh birds at a continental scale. Moreover, our synthetic approach provides a state-of-the-art framework for modeling species distribution as a function of optimally-predictive habitat attributes, and translating such models into habitat suitability maps that will prove extremely useful for wildlife conservation and management.

STYHL, TYRELL *1, Meisman, E.D.2, B. Krouse3, M. Bechard4, R. Miller5, M.D. Johnson6, and D. Perkins7. 1College of Natural Resources, Dept. of Fish and Wildlife Sciences, University of Idaho, Moscow, Idaho 83843. 2College of Natural Resources and Sciences, Dept. of Wildlife Biology, Humboldt State University; Raptor Research Center, Dept. of Biological Sciences, Boise State University. 3School of Culture, History and Politics, Dept. of Geography, College of Western Idaho, Nampa. 4Raptor Research Center, Dept. of Biological Sciences, Boise State University, Boise. 5Intermountain Bird Observatory, Dept. of Biological Sciences, Boise State University. 6College of Natural Resources and Sciences, Dept. of Wildlife Biology, Humboldt State University. 7School of Science, Technology, Engineering, and Math, Dept. Of Life WS Sciences College of Western Idaho; Raptor Research Center, Dept. of Biological Sciences, Boise State University. **OSPREY HABITAT SUITABILITY AT THE RURAL-URBAN INTERFACE IN CENTRAL IDAHO.**

Ospreys (*Pandion haliaetus*) are fish-eating, top predators of aquatic ecosystems that serve as useful sentinel species for monitoring environmental contaminants and ecosystem health. Ospreys further appear highly adaptable to human-dominated landscapes and readily nest on artificial structures that occur within an array of land use and land cover (LULC) types and human settlement regimes. In Long Valley Idaho, the abundance of breeding Ospreys has remained relatively stable since the late 1970's yet the distribution of nests and nest substrate use has changed. To evaluate if changes in nest structure availability, coupled with increasing anthropogenic landscape conversion, could be changing osprey nest site selection and success, we evaluated relationships among nest site characteristics and osprey breeding activities. We used multivariate generalized linear models with model selection procedures to evaluate the relative importance of LULC composition and nest site characteristics associated with nest occupancy and daily survival rates. Preliminary results from 2015-16 demonstrate changes in available nesting substrates compared to historic data. Our models also suggest that distance to water and roads are correlated with patterns of territory occupancy while distance to water and land cover types (water, agricultural and grassland) are correlated with nesting success. Here, we present breeding population monitoring data, trends in available nesting substrates, and output from habitat suitability models for the 2015 – 2017 breeding seasons. Additionally, we discuss the implications of changing land use patterns and substrate availability on osprey breeding ecology and management.

TOWNSEND, KASSANDRA*1, TALIA JOLLEY*1, Zach Sanchez1, Dusty Perkins1, Bryan Krouse1, Steve Alsup2, Joseph Weldon3, Matthew Stuber4. 1College of Western Idaho, Nampa, ID 83686. 2Birds of Prey NCA Partnership, Boise, ID 83705. 3Boise District Bureau of Land Management, Boise, ID 83705. 4U.S. Fish and Wildlife Service, Migratory Birds and Habitat Program, Pacific Region, Portland, OR 97232. **BREEDING ECOLOGY AND HABITAT SUITABILITY OF FERRUGINOUS HAWKS (BUETO REGALIS) IN SOUTHERN IDAHO.**

Ferruginous Hawks are the largest North American buteo (soaring hawks) and are avian apex predators known to inhabit grassland and shrub steppe ecosystems in the western United States. Their apparent sensitivity to a variety of ecological parameters associated with climate change and increasing anthropogenic landscape change makes them an appropriate indicator species of ecosystem health. In the Great Basin, widespread habitat alteration associated with invasive annual grasses, increased fire frequency, and increasing anthropogenic encroachment within breeding habitats have been suggested as drivers of breeding population declines. Currently the Ferruginous Hawk is listed as a "Species of Greatest Conservation Need" by the Idaho Department of Fish and Game, and as a "Type II Sensitive Species" by the Bureau of Land Management, with the loss of uitable habitat listed as a primary threat. Despite this status, there is little published information available on the distribution, demography and reproductive performance of Ferruginous Hawks in southern Idaho. To better understand the characteristics of southern Idaho's breeding population we are establishing a long-term collaborative monitoring program to provide baseline data on the ecology and population demography of Ferruginous Hawks in and around the Morley Nelson Snake River Birds of Prey National Conservation Area. We monitored 74 breeding territories and documented territory occupancy and productivity between March and July 2017. We used a multivariate generalized linear model with model selection procedures to evaluate the relative importance of ecological attributes and human disturbance agents on Ferruginous Hawk breeding success. Here, we present the results of our monitoring and preliminary models, and discuss their implications for Ferruginous Hawk breeding ecology and management.

TYCZ, BRANDON and J. Jenks. South Dakota State University, Brookings, South Dakota 57007. **REPRODUCTIVE RATE, FOOD HABITS, AND NUTRITIONAL CONDITION OF BOBCATS IN SOUTH DAKOTA.**

Bobcat (*Lynx rufus*) population characteristics in South Dakota can vary locally and annually; however, sparse information is available on populations inhabiting western South Dakota. We collected 1,208 carcasses of bobcats that were legally harvested from 2012 to 2015 in South Dakota. The highest statewide reproductive rate was during the 2012-2013 season (placental scars; 1.87, SE = 0.10), which was statistically higher ($P < 0.001$) than for bobcats harvested during the 2013–2014 season. The 2013–2014 season was the least productive season, with the lowest pregnancy (46.9%) and reproductive rates (1.14, SE = 0.14). The Kidney Fat Index progressively declined annually throughout the study; values for the 2014–2015 season were statistically less ($P < 0.001$) than prior years. Although both indices declined temporarily, there was little correlation between the Kidney Fat Index and number of placental scars ($r2 = 0.02$). Our findings support a prey population decline based on low reproductive rates and declining Kidney Fat Index; however, the 2014–2015 bobcat harvest season indicated an increase in reproductive rates potentially signifying that the population has the potential to rebound.

BERGEN, SCOTT, J. Horne, and M.Hurley. Idaho Dept. of Fish and Game. **ACCURACY ASSESSMENT OF UNGULATE SEASONAL RANGE ESTIMATES USING NEW GPS LOCATION DATA.**

Last year we presented seasonal range maps for elk and mule deer throughout the state of Idaho using maximum entropy modeling techniques. Using newly acquired GPS location data not used to develop the model we test the accuracy of the previous year's models for mule deer and elk for their accuracy in predicting seasonal ranges. For elk winter range (statewide), the average winter range used by elk was 0.49881 (± 0.196183). For elk summer range, elk use averaged 0.47808 (± 0.190232). Mule Deer in their winter range average 0.462378 (±0.19003). Mule deer in their summer range averaged 0.435144 (±0.18101). This use by ungulates performed above suggested 'threshold' values for these ranges, which is pretty good considering how harsh last winter was in parts of Idaho. Suggestions will be made for improvement in the performance of seasonal range models for ungulates in Idaho.

BOND, PAM. Idaho Department of Fish and Game, Boise, ID 83712. **YOUR PHONE IS AN AWESOME GPS.**

As a GIS Analyst for IDFG, I get plenty of questions from field staff asking how to load different layers and maps onto their traditional GPS units (Garmin, DeLorme, etc.) and sometimes it is downright impossible. More and more I find myself telling them to use their smart phones and tablets instead because it is so much easier to download data and different basemaps. This IGNITE! presentation will give you a brief overview of a couple GPS apps I recommend and tips and tricks for using smart phones and tablets in the field.

FREEMAN, ERIC, Zach Lockyer, and Cheryl Hone. Idaho Department of Fish and Game, Pocatello, Idaho, 83204. **USING REMOTELY-SENSED CAMERAS TO CLASSIFY MULE DEER POPULATIONS.**

Mule deer are an iconic western wildlife species with a devoted following of sportsmen and women. As such, wildlife management agencies closely monitor many mule deer populations. These data allow wildlife managers to make informed decisions when considering actions that may impact mule deer populations (i.e., harvest management, habitat improvement, etc.). Common metrics of population performance include age and sex ratios, adult and fawn survival, and population size. Unfortunately, these data can be difficult or expensive to collect. We utilized remotely sensed cameras to monitor the mule deer population that migrates to the bear lake plateau, and attempted to compile age and sex ratio data from the pictures. We intend to compare these ratios to data collected from aerial herd composition surveys to determine if this

is an effective and efficient method for collecting age and sex ratio data for mule deer. We also hope to gather data on migration timing and develop recommendations for analyzing this type of data.

GILBERT, SOPHIE[1], Kayte Groth[1], John Guthrie[1,2], Shane Roberts[2], Jon Horne[2], Mark Hurley[2].
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QUANTIFYING DEER AND ELK BEHAVIOR AND EFFECTIVENESS OF DEPREDATION PREVENTION TREATMENTS IN AGRICULTURAL LANDSCAPES OF IDAHO.

Ungulates, particularly deer and elk, cause considerable damage to agricultural crops across the state of Idaho, yet their habitat and movement ecology is poorly understood in these environments. Our study aims to better understand season- and behavior-specific habitat selection of white-tailed deer and elk in 2 agricultural landscapes in Idaho (Clearwater Region and Magic Valley/Southwest Regions), and to test fear-increasing and nutrition-reducing treatments for preventing deer and elk depredation of crops. Here, we provide a project update and timeline.

KRISTOF, ANDREA A.*[1], Brian Wehausen[1], Benyamin Wishnek[2], and Kenneth Scheffler[3].

[1]Camas National Wildlife Refuge, Hamer, Idaho 83425. [2]Bear Lake National Wildlife Refuge, Montpelier, Idaho 83254. [3]Grays Lake National Wildlife Refuge, Wayan, Idaho 83285.

INVESTIGATING THE DECLINE AND DECREASED RESILIENCE OF THE GREATER YELLOWSTONE TRUMPETER SWAN IN IDAHO.

The Trumpeter swan is a charismatic and conspicuous species that provides a good indicator of wetland habitat condition due to its nearly obligatory herbivorous diet, large body size, high visibility, and long-lived life history. The Tri-state area of Idaho, Montana, and Wyoming harbors the Greater Yellowstone (GYE) population of Trumpeter swans, a non-migratory population that comprised one of the last remaining populations of the entire species in the early 20th century. Today, this population displays a decline of breeding pairs in some portions of its range and consistently poor recruitment in other areas. The extent and causes of this decline are not understood. The two leading hypothesized explanations involve (1) inbreeding depression as a consequence of limited genetic diversity, and (2) bioaccumulation of a contaminant that negatively affects reproduction. This project aims to understand the demography and habitat use of GYE Trumpeter swans breeding in Idaho, and to investigate whether contaminants and/or reduced genetic variability may pose a conservation risk to this population. This project will commence during the 2018 breeding season, take place over a minimum of three years, and span the Bear Lake, Camas, and Grays Lake National Wildlife Refuges with the potential to expand to state lands and National Forests. It will include the marking and sampling of both adults and fledglings, genetic analysis, reproductive success monitoring, contaminants screening, and resighting surveys. The anticipated outcomes of this project are to (1) document the extent of the GYE Trumpeter swan population decline, (2) identify the demographic stage(s) of the population that are being affected, and (3) investigate whether field evidence supports either or both of the two leading hypothesized factors as a cause for the population decline. This will inform the development of a management strategy aimed at improving GYE Trumpeter swan population sustainability and resilience.

SHURTLIFF, QUINN, Veolia North America, Idaho Falls, Idaho 83274. **GETTING MORE OF WHAT MATTERS DONE AT WORK AND AT HOME.**

Most of us are extremely busy at work, and it often feels like we are running faster and faster just to stay in the same place. It is easy to get sucked into a routine of doing the most urgent things at the expense of the most important things, which if done, would allow you to accomplish your highest priorities. In light of this year's theme, I invite you to focus on "The Future of the [your]

Wildlife Profession". I will share principles, tools, and tips from the conservation planning world, the self-improvement literature, and from my own experience that can help you take control of your own future in the wildlife profession. Both professional and personal life will always be busy and full of distractions. Your aim should be to learn how to live each sector of your life deliberately—to establish your vision, chart your course, and pursue your measurable objectives relentlessly and routinely. I have not yet arrived, but I invite you consider if what I am trying to implement in my professional and personal life could help you get better every day and to achieve your goals.

STITT, JESSICA*, L.K. Svancara, L.A. Vierling, and K.T. Vierling. University of Idaho, Moscow, ID 83844. **SMARTPHONE LIDAR CAN MEASURE KEYSTONE HABITAT STRUCTURES FOR WILDLIFE STUDIES.**

Remote sensing technologies are increasingly able to measure environmental characteristics important for wildlife, but these technologies are sometimes limited in their ability to measure characteristics at the spatial resolution necessary for wildlife studies. Keystone structures are features that play a disproportionately large role in structuring community composition, and some keystone structures (e.g. snags, tree cavities) often occur over small spatial extents. We tested a handheld lidar device that interfaces with smartphones and tablets called Spike® by IkeGPS to determine if it could accurately measure snag sizes and cavity dimensions across various conditions. The Spike app allows users to take a photo of a target (i.e. a snag or tree cavity) and then measure the dimensions of that target on their phone or tablet. We measured diameter at breast height (DBH) with a standard tape measure and took Spike photos of the same tree from distances up to 50 m away in conifer forests in Washington and Idaho. Correlations between Spike measurements and DBH tape measures were high ($r = 0.98$, $n = 103$), and correlations between Spike measurements and known cavity dimensions for 4 different cavity sizes (ranging from 3 to 12 cm wide) were also high ($r > 0.91$) when measured at various heights off the ground, angles offset from center, and distances from the cavities ($n = 294$ measurements). Spike is a low-cost, portable technology that can non-invasively measure features small in size and difficult to access, and shows great potential to aid in future research as well as citizen science education and outreach efforts across a wide range of fields. With the rate at which remote sensing technologies continue to develop, Spike and similar handheld lidar devices may herald the advent of powerful and practical tools to remotely explore our world from the palm of our hand.

WISHNEK, BEN. Bear Lake National Wildlife Refuge, Montpelier, Idaho 83254.

SECRETIVE MARSHBIRD BASELINE MONITORING AT BEAR LAKE NATIONAL WILDLIFE REFUGE.

Bear Lake National Wildlife Refuge serves as an important breeding and stopover wetland complex of actively managed semipermanently flooded impoundments for many species of waterbirds. Some of these species, including sora (*Porzana carolina*), Virginia rail (*Rallus limicola*), American bittern (*Botaurus lentiginosus*), pied-billed grebe (*Podilymbus podiceps*), and Wilson's snipe (*Gallinago delicata*), can serve as good indicators of habitat condition and are often not readily visually detected during waterbird surveys. Playback call surveys were conducted for the aforementioned species on the refuge from 2005-2010. Most recently, 3.99 birds/point/survey were detected in 2010 across fourteen survey points. These species are being monitored in order to evaluate the relative success of management actions. Much of the semipermanent wetland habitat on the refuge is in late successional stage with emergent vegetation to open water ratios heavily skewed towards emergent vegetation and in need of disturbance to create more of a hemi-marsh condition. Habitat manipulations including prescribed fire, disking, herbicide application, drawdown and haying have been implemented more heavily beginning in 2016 to assist in setting back succession. Playback call surveys were conducted at a total of nine points across three units beginning in spring 2017 to get a baseline of relative abundances of each species before management actions were implemented in summer and fall of 2017. These units are planned to be surveyed again every other year beginning in 2018 to assess trends in relative abundances of target species. New survey points and units will be added in coming years as additional units are brought into a more frequent rotation of habitat manipulation. Data from these surveys will be used to inform management on the relative efficacy of the suite of management actions performed in each unit in enhancing secretive marshbird habitat.

ADAMS, MCKENNA* and Colden V. Baxter. Stream Ecology Center, Department of Biological Sciences, Idaho State University, Pocatello, Idaho 83209. **BIRDS AND BUGS IN A WILDERNESS RIVERSCAPE: INVESTIGATION OF RESOURCE WAVE PROPAGATION AND EXPLOITATION**

We are studying the phenology of salmonfly (*Pteronarcys californica*) emergence, and the foraging responses of western tanagers (Piranga ludoviciana) and Lewis's woodpeckers (Melanerpes lewis) in the Salmon River Basin of central Idaho. We conducted surveys of adult salmonflies and their exuviae, as well as counts of western tanagers and Lewis's woodpeckers, and observations of their foraging behaviors throughout June and early July 2017. Preliminary evidence suggests that phenology of the salmonfly emergence, which occurs from a given habitat as a synchronous pulse over a few days and is water temperature dependent, typically proceeds overall in a downstream to upstream direction. However, we observed discontinuities in emergence associated with major tributary confluences, such as the confluence of the Middle Fork and mains tem Salmon River. Emergence occurred from the main stem Salmon River first upstream then downstream of the confluence, presumably due to the influence of the Middle Fork's colder water temperatures mixing with the main stem. Wherever we observed live adult salmonflies we also observed western tanagers and Lewis's woodpeckers, whereas they were rarely detected where adult salmonflies were absent. Western tanagers and especially Lewis's woodpeckers were also observed actively foraging on adult salmonflies. Studying this phenomenon in a riverscape context will allow us to detect patterns and potential relationships at multiple scales within the Salmon River basin. Together these organisms make a good system by which to evaluate the propagation and exploitation of a "resource wave" that links water and land. It also provides insight into the ecology of both invertebrate and vertebrate animals of conservation concern, and that are iconic members of Idaho's wilderness.

CAMP, MEGHAN J.[1]*, L. A. Shipley[1], and J. Varner[2], [1]Washington State University, Pullman, WA 99163, [2] Colorado Mesa University, Grand Junction, CO 81505, **BEHAVIOR AND ACTIVITY PATTERNS OF AMERICAN PIKAS AT CRATERS OF THE MOON NATIONAL MONUMENT AND PRESERVE.**

American pikas (*Ochotona princeps)* are small mammals that typically reside in rock debris on high-elevation mountain slopes. Because they are sensitive to hot temperatures and cannot easily move to new habitats, some populations of pikas could be at risk in the face of climate change. This charismatic animal has therefore been considered by some biologists as a sentinel species for climate change. However, a population of pikas exists at Craters of the Moon National Monument and Preserve, an extensive, low-elevation lava flow in Idaho that experiences much hotter temperatures than typical pika habitat. We investigated how pikas use the unique lava

landscape at Craters of the Moon to buffer exposure to hot temperatures. Specifically, we compared activity patterns and foraging behavior of pikas at Craters of the Moon with pikas from typical alpine habitats in the nearby Pioneer Mountain Range. Pikas at Craters of the Moon demonstrated a more crepuscular activity patterns compared to pikas in the Pioneer Range, presumably to avoid hotter, midday temperatures. Pikas at Craters of the Moon also began haying earlier in the season, had less diverse diets, larger home ranges, and displayed less territoriality compared to the Pioneer population. Our findings provide a better understanding of American pikas' ability to behaviorally adapt to warmer temperatures and thus may provide insight into the long-term viability of their populations in the face of global climate change.

CLENDENIN, HEATHER[1]*, J. Hayden[2], D. Ausband[2], P. Hohenlohe[1], and L. Waits[1].

[1]University of Idaho, Moscow, Idaho 83844; [2]Idaho Department of Fish and Game, Coeur d'Alene, Idaho 83815. **ESTIMATING BREEDING PACKS BY COUNTING LITTERS: GENETIC RECONSTRUCTION OF SIBLINGS AMONG HARVESTED YOUNG OF THE YEAR.**

Documenting parameters of reproductive success within managed wildlife populations is a critical component of population monitoring. However, comprehensive and cost-effective monitoring using traditional methods, such as direct observation and telemetry, may prove difficult for species that are remotely located, behaviorally elusive, cryptic, or distributed across broad ranges. Under these circumstances, genetic monitoring can be an efficient approach to obtaining reliable demographic information. In this study, we demonstrate a novel use of genetic data to estimate a minimum annual count of reproductively active packs of gray wolves (*Canis lupus*), highlighting methods to optimize accuracy and certainty. Using tissue samples from wolves harvested in the state of Idaho, 98 young of the year from 2015 and 205 from 2016 were genotyped at 18 microsatellite loci. Sibling groups for each cohort were reconstructed using COLONY, with full-sibling litters corresponding to unique pairs of breeding adults. Young of the year of known relationship from long-term study packs within the state were added to the dataset (61 individuals from 2015 and 45 from 2016), allowing for evaluation of the software's performance in correctly distinguishing true siblings from unrelated individuals. Systematic variation of input parameters allowed us to compare the power and certainty of sibling assignments under conditions likely to be encountered when working with real-world data (e.g. population allele frequencies estimated across different timescales and geographical distributions, variations in number of loci, and inclusion of known relationships). This study provides insight into the use of sibship reconstruction as a unique and potentially powerful tool to meet wildlife monitoring goals.

DUPUIS, AUSTIN*[1], A. Welker[1], S. Nerkowski[1], J. Rachlow[1], L. Shipley[2], and L. Waits[1].
[1]University of Idaho, Moscow, ID 83843, [2]Washington State University, Pullman, WA 99164.
VEGETATIVE ANALYSIS OF COLUMBIA BASIN PYGMY RABBIT (*BRACHYLAGUS IDAHOENSIS*) HABITAT.

Loss and fragmentation of native shrub-steppe habitat has led to the decline and extirpation of the Columbia Basin pygmy rabbit (CBPR) in Washington state. In 2001, the last remaining 16 CBPR were removed from the wild to begin a captive breeding program. In 2011, the breeding program transitioned to an onsite program with the goal of reestablishing wild populations within central Washington where they were originally removed from. Since 2011, 1947 rabbits have been released onto Sagebrush Flats Wildlife Area (SBF). Since 2015, only ~25% of active burrows are found on SBF, the rest have transitioned to surrounding Conservation Reserve Program (CRP) land. The objective of this study was to identify factors that have led to the transition of active burrows from SBF to CRP. We hypothesize that concealment, as well as canopy cover, are greater in CRP vs SBF. Line transects and 1m plot boxes were used to determine canopy cover, plant diversity, and plant coverage. Surveys were performed to evaluate terrestrial and aerial concealment, and the quality of sagebrush and soil. ANOVA's and mixed effect modeling were used to characterize the relationship between concealment, canopy cover, and burrow location. This data will be used to help determine optimal habitat for future pygmy rabbit release sites. This is important, because in summer 2017, a fire destroyed one of the few plausible release sites, as well as one of four breeding enclosures, that held more than 100 rabbits. CBPR managers hope to use this information to identify more suitable habitat, to expand the range from solely SBF, for future release.

GILTZ, PATRICK D. * and Charles R. Peterson. Department of Biological Sciences, Idaho State University, Pocatello, Idaho 83209-8007. **THE IDAHO AMPHIBIAN AND REPTILE iNATURALIST PROJECT 2017 UPDATE.**

Data on the occurrence and distribution of amphibians and reptiles are needed to identify and address conservation problems for these species. Observations from crowdsourced / citizen science projects can be an important source of data for conservation and management. The goal of this project is to improve available data for Idaho amphibians and reptiles. The Idaho Amphibian and Reptile iNaturalist Project was initiated in June of 2016 by the ISU Herpetology Laboratory using iNaturalist, an application from the California Academy of Sciences that allows people to contribute observations of organisms using their mobile devices. Since January 2017, the number of records increased from 350 to 980 observations of 37 of the 38 established species of Idaho amphibians and reptiles. The number of participants increased from 84 to 223, including students, teachers, agency personnel, and interested citizens. Recruitment efforts included presentations to middle school, high school and university classes, teacher workshops, Idaho Master Naturalist chapters, and several conservation organizations. Despite these efforts, just 10

users contributed 48% of all of the observations in the project. A comparison of iNaturalist observations with museum, survey, and other contributed observations for the Portneuf Watershed indicated that although only 18% of the total records were obtained from iNaturalist, they make up the majority of records since year 2000. We are currently developing a spatial-statistical model to understand the factors influencing the densities of amphibian and reptile observations across the state. This model should help in using iNaturalist records to evaluate the status and trends of Idaho's amphibian and reptiles.

GROTH, KAYTE [*1], Jon Horne[1], and Sophie Gilbert[2]. [1]Idaho Department of Fish and Game, Lewiston, Idaho 83501. [2]University of Idaho, Moscow, Idaho 83844. **USING HIGH-FREQUENCY GPS RELOCATIONS TO EVALUATE FEAR-ENHANCING TREATMENTS FOR REDUCING WHITE-TAILED DEER DEPREDATION OF AGRICULTURAL CROPS**.

In the Clearwater region of northern Idaho, as in many other parts of North America, white-tailed deer (WTD) cause significant damage to high-value crops in agricultural areas. However, despite these ongoing and significant damages in the Clearwater region, few successful deterrents have been identified. To meet this need, our project aims to develop management tools that will reduce agricultural crop damage through behavioral modifications designed to reduce WTD use of agricultural fields. We will test the efficacy of 4 deterrent treatments intended to interfere with the detection of or mimic natural predation risk. We will evaluate the effectiveness of these deterrents for reducing use of fields by capturing 65 WTD does and fitting them with GPS-collars that will record locations every 15 minutes throughout the crop growing season. We currently have 40 GPS-collared WTD does in two study areas, and will collar the remaining 15 this S spring. We will develop a movement classification algorithm to identify individual preferred. foraging patches located in or near a depredated crop field. We will then deploy treatments to each collared doe's identified foraging patches at 2 week intervals, alternating between treatment and no-treatment periods. Treatments will include: 1) signal-jamming (i.e., a white-noise machine to remove the ability to hear predators or conspecific warning signals); 2) false visual signaling (i.e., a white flapping flag to imitate the warning sign of an erect deer tail); and 3) false scent signaling (i.e., an automated scent pump that expels synthetic versions of the volatile components found in wolf urine at regular intervals); and 4) a treatment that is a combination of these 3 treatments. We will then analyze the efficacy of these treatments by quantifying changes to space use and comparing movements between pre- and post-treatments. At the conclusion of this project, we expect to be able to quantify growing-season time budgets and the effectiveness of our 4 deterrent treatments in reducing the amount of time the collared deer spent foraging in a treated agricultural field.

GUTHRIE, JOHN*[1], Sophie Gilbert[1], and Shane Roberts[2]. [1]University of Idaho, Moscow, Idaho 83844. [2]Idaho Department of Fish and Game, Idaho Falls, Idaho 83401. **MODIFYING ELK BEHAVIOR TO REDUCE CROP DAMAGE AND INCREASE SOCIAL CARRYING CAPACITY IN AN AGRICULTURE DOMINATED LANDSCAPE**

Burgeoning elk populations in southern Idaho have resulted in significant increases in agriculture crop damages and damage complaints from landowners. While efforts have been made to minimize or prevent these damages, deterrents employed to date have proven costly and only partially and/or temporarily effective. Wildlife managers need reliable methods for mitigating impacts of elk to private land while providing for healthy populations that offer quality hunting opportunities. We will develop and test deterrent treatments, designed to prevent elk from utilizing agriculture crops during the growing season. We identified 5 study areas with chronic elk depredation issues throughout south-central and southwest Idaho. Within these areas we will capture 30 elk in herds that have historically utilized agriculture fields during the growing season. Captured elk will be fitted with high-frequency GPS collars, capable of recording elk relocations every 10 minutes during 2 growing seasons. Using GPS collared elk, we will identify target fields, where depredations are actively occurring to determine where deterrent treatments will be deployed. We will then use behavioral responses of collared elk and observational assessments of total elk use in target fields, or groups of target fields, before and after treatments to quantify elk responses to deterrent treatments. Deterrents to be tested will include; 1) targeted lethal removal of elk (non-collared) actively utilizing agriculture fields; 2) pasture fence modification to exclude elk from crops; 3) aversive conditioning through use of livestock herding dogs; and 4) private land lure crops planted to encourage elk away from areas prone to chronic depredations. We will measure spatial and temporal elk movement behavior in response to treatments and analyze the changes in behavior before and after treatments are deployed. Our ultimate intentions of this research will be to determine which methods are most efficient and effective in preventing and mitigating crop damages caused by elk.

HAY, LESLIE A., Kayla Hiatt, Michaela Hersh, and Johanna Hay-Smith. Lewis Clark State College, Lewiston, ID. **USE OF CAMERA TRAP MONITORING TO DETECT ABUNDANCE AND DISTRIBUTION OF JAGUAR AND OTHER FOREST CARNIVORES/PREY SPECIES IN COSTA RICAN NEOTROPICAL RAIN FORESTS.**

The goal of this study is to evaluate differences in presence, relative abundance and distribution of felids and their prey in three neotropical rainforest areas in Costa Rica. We monitored network trails using 80 Bushnell cameras with scent lures at two low and one high elevation rainforest sites. Five felid species were recorded in two rainforest protected areas at different elevations including jaguar (*Panthera onca*), puma (*Puma concolor*), ocelot (*Leopardus pardalis*), margay (*Leopardus weldii*), and jaguarundi (*Puma yagouaroundi*) along with several mammalian and avian prey species. Felids and prey species were observed diurnally and nocturnally in trail cameras and in all habitats. We recorded 29 observations of jaguar in both forest sites, with a higher incidence at high elevations. Puma were observed 105 times at camera stations with occurrences at both high & low elevations. Prey species are diverse and vary significantly in abundance at both low and high elevation sites. We recorded 13 species of forest mammals that are prey to felines at low and high elevation sites. Of the total species observations, ungulates (i.e., peccaries and tapir) comprised 29%, meso-mammals including large rodents (i.e., paca and agouti) comprised 46%, and large ground dwelling birds (i.e., curassow, guan and tinamou) comprised 25% of observations. Relative abundance indices demonstrated a wide range for all wildlife species, with higher RAIs at the high elevation sites with less human activity. Many small to large groups of peccaries (*Tayassu pecari* & *T. tajacu*) were observed with juvenile recruitment, along with tapir (*Tapirus bairdi*i) at the high elevation site. Wildlife were frequently recorded in pairs in the same photo or video including puma, tapir, raccoon, coati, and peccaries. Animals were strongly attracted to the perfume scent lure (Calvin Klein Obsession) with subsequent behavioral observations (e.g., sniffing, rubbing, rolling, resting at scent stations). In summary, mammalian carnivores and prey species were diverse in all three tropical rainforest sites, but diversity and frequencies were lower at low elevations where the habitat is more fragmented with higher human presence.

KRISTOF, ANDREA* and Brian Wehausen. Camas National Wildlife Refuge, Hamer, Idaho 83425. **EXPERIMENTAL RESTORATION OF NON-NATIVE CRESTED WHEATGRASS MONOCULTURE TO SAGE-STEPPE ASSEMBLAGES.**

Crested Wheatgrass (*Agropyron cristatum*) is a perennial grass that has been widely introduced throughout the arid western United States. It competes aggressively with native grasses, and forms monocultures that support significantly less biodiversity than native sage-steppe assemblages. Little information exists on the successful restoration of upland habitat from Crested

Wheatgrass monoculture. This species poses a significant obstacle to habitat restoration at Camas and Minidoka NWRs in southeast Idaho. As part of an effort to determine the most effective and efficient means to restore the upland habitat at these refuges, we established five experimental plots at Camas NWR to test the efficacy of four different treatment regimens aimed at reducing the cover of Crested Wheatgrass while allowing for the re-establishment of native grasses and forbs. These treatments include 1) the application of Journey herbicide (21.94% glyphosate and 8.13% imazapic) at an 11 ounce/acre rate, 2) the application of 4 pound glyphosate (41.0% glyphosate) at a 96 ounce/acre rate, 3) mowing followed by an application of 4 pound glyphosate at a 96 ounce/acre rate during the subsequent growing season, and 4) the application of Journey herbicide at a 32 ounce/acre rate. Baseline vegetation inventories and initial treatments were completed during May of 2017. Here, we summarize the pre-treatment conditions within the experimental plots, and the within-season efficacy of each treatment. In 2018, we will assess each plot for bunchgrass regrowth and sprout density. Plots that do not exhibit significant bunchgrass regrowth may be candidates for native seed distribution in fall 2018. The results of this project will contribute essential information to shape the methodology for large-scale restoration of native upland habitat at these refuges.

KRISTOF, ANDREA*[1,2] and Bruce Dugger[1]. [1]Oregon State University, Department of Fisheries and Wildlife, Corvallis, OR 97331. [2]Camas National Wildlife Refuge, Hamer, Idaho 83425.

IMPROVING MANAGEMENT OF STOPOVER HABITAT FOR MIGRATORY WATERBIRDS BY UNDERSTANDING THE FACTORS THAT SHAPE SUBMERGED AQUATIC VEGETATION COMMUNITIES.

The persistence of waterbird species requires the conservation of the wetland ecosystems upon which they depend for all parts of their annual cycle. Intermountain West wetlands are naturally rare on the landscape and have endured over a century of destruction and modification. Those that remain are disproportionately important to wildlife. Relatively little is known about the habitat needs of waterbirds during migration, in particular their use of submerged aquatic vegetation beds that provide valuable energy resources. In this study, we contributed to the development of a state-and-transition model to improve management of these stopover habitats by 1) empirically defining submerged aquatic vegetation communities that occur in the Intermountain West, and 2) describing the abiotic context associated with each vegetation community. We sampled the vegetation and abiotic conditions within 42 wetland units spanning 12 National Wildlife Refuges between 2015 and 2017. We used a hierarchical agglomerative cluster analysis in combination with an indicator species analysis to objectively and empirically identify eight submerged aquatic vegetation communities. We assessed the value of these groupings to a management model by evaluating the relationship between each vegetation community to local abiotic conditions including hydroperiod, water quality, and soil characteristics. We used a non-metric multidimensional scaling ordination to display the relative strength of each vegetation

community's association with these abiotic variables. We then constructed linear mixed models to quantify the odds of a vegetation community occurring within a given set of abiotic conditions. This knowledge will expand our understanding of submerged aquatic vegetation communities and the abiotic processes that shape them, and provide a basis for wetland management models that include objectives for submerged aquatic vegetation beds.

MILLER, PAIGE*, J. Ortiz, C. Baxter, and J. Starkey. Idaho State University, Pocatello, Idaho 83209. **INVESTIGATING THE INFLUENCE OF HABITAT HETEROGENEITY ON DIVERSITY OF INSECTIVOROUS BIRDS IN A RIVER-FLOODPLAIN MOSAIC.**

Rivers are fundamentally linked to their adjacent terrestrial ecosystems. In particular, within river-floodplains, the emergence of adult aquatic insects constitutes a resource flux of potential importance to bird communities, and the magnitude composition and timing of this emergence varies across the mosaic of aquatic habitats within these ecosystems. In our study, we are assessing the importance of habitat heterogeneity, through its influence on patterns of insect emergence, on the overall density, species richness, and biodiversity of insectivorous birds across 7 unique habitats within the Fort Hall Bottoms floodplain segment of the Snake River. From January to December 2017, we conducted three bird point-counts monthly at each habitat, separated by 50-meter line transects. Overall, we observed higher bird abundance and richness at lotic (flowing-water) habitats than lentic (standing-water) habitats. In total, 27 species of insectivorous birds have been observed; several species have been ubiquitous, whereas others have been exclusively observed in specific habitats. A thought-experiment, whereby we sequentially and randomly aggregated species richness from all the unique habitats, revealed richness increasing curvilinearly with increasing habitat heterogeneity. We hypothesize that this pattern is linked to the asynchrony of insect emergence among habitats, such that the complexity of the mosaic sustains elevated bird diversity by providing more consistent and diverse prey resources.

MILLING, CHARLOTTE R.[1], Janet L. Rachlow[1], P.J. Olsoy[2], M.A. Chappell[3], T.R. Johnson[4], J.S. Forbey[5], L.A. Shipley[2], D.H. Thornton[2]. [1]Department of Fish and Wildlife Sciences, University of Idaho, Moscow, ID 83844, [2]School of the Environment, Washington State University, Pullman, WA 99164, [3]Department of Evolution, Ecology, and Organismal Biology, University of California, Riverside, CA 92521, [4]Department of Statistical Science, University of Idaho, Moscow, ID 83844, [5]Department of Biology, Boise State University, Boise, ID 83725

HABITAT STRUCTURE MODIFIES MICROCLIMATE: AN APPROACH FOR MAPPING FINE-SCALE THERMAL REFUGIA.

Contemporary techniques predicting habitat suitability under climate change projections often underestimate availability of thermal refugia. Habitat structure contributes to thermal heterogeneity at a variety of spatial scales, but quantifying microclimates at organism-relevant resolutions remains a challenge. Landscapes that appear homogeneous at large scales may offer patchily distributed thermal refugia at finer scales. We quantified the relationship between vegetation structure and the thermal environment at a scale relevant to small, terrestrial animals using a new approach for mapping fine-scale thermal heterogeneity. We expected that vegetation would create attenuated microclimates and that the influence of vegetation structure would vary seasonally. We measured shrub volume, horizontal cover, and operative temperature (T_e) in a sagebrush-steppe habitat in Idaho, USA, at 534 microsites across two study sites of approximately 1 km^2 each. We modeled relationships between habitat structure and both mean daily maximum temperature (T_{max}) and mean diurnal temperature range (DTR) for each study site during summer and winter. Aerial imagery from unmanned aerial systems was used to estimate shrub volume and canopy cover at 1-m resolution, and we applied the best fit model to map thermal heterogeneity across broader extents. Increasing shrub volume and cover was associated with lower T_{max} and DTR, but strengths of the relationships differed between study sites. There was considerable heterogeneity in availability of thermal refugia across sagebrush-steppe rangelands that have traditionally been considered relatively homogeneous. This technique can help wildlife biologists and land managers identify critical thermal refugia that large-scale climate modeling can overlook and thus contribute to an understanding of animal-habitat relationships under changing climates and land uses.

NIGHTINGALE, EMILY D.*, K.N. Fletcher, and J.L. Rachlow. Department of Fish and Wildlife Sciences, University of Idaho, Moscow, ID 83501. **MAKING THE CONCEPT OF "COVER" MORE EXPLICIT IN WILDLIFE-HABITAT ECOLOGY**.

The concept of cover is used generally in wildlife habitat studies to refer to structural habitat features that provide one or more functions, such as reducing thermal stress or enhancing security. Despite extensive use, the concept remains loosely defined in the wildlife literature. Our objectives were to assess how wildlife ecologists are using the term cover in the context of

habitat studies, and to develop a framework to operationalize the concept in animal-habitatrelationships. We categorized functions of cover (e.g., thermal shelter) and properties of the environment that provide those functions (e.g., interception of solar radiation). We selected papers published during 1995-2015 using the Web of Science by searching the words "cover" and "habitat". This returned 1,112 articles, and we randomly selected a third for review. We evaluated each study to identify if the following were defined or measured: 1) functions of cover;2) properties that provided specific functions; 3) habitat features that created cover; and 4) methods for measuring cover. Protection from predators was the most common function attributed to cover, however, few studies measured or even defined properties that provided that function (e.g., concealment, enhanced detection of predators, physical barrier). We contend that cover should be defined explicitly by the function(s) that it serves, and that it should be measured as *functional properties* of the habitat. Explicit evaluations of cover in field studies will help to advance understanding of wildlife-habitat relationships, increase our ability to predict animal responses to habitat changes, and help wildlife and land managers to develop more effective habitat management plans.

OETTING, ANNA*, Linscott, Mason, T., Parent, Christine, E. University of Idaho, Moscow, Idaho 83843. **THE DIVERSITY AND CONSERVATION OF MOUNTAINSNAILS (*OREOHELIX*) FROM THE LOWER SALMON RIVER.**

Mountainsnails (genus *Oreohelix*) of the Rocky Mountains are one of the most morphologically and taxonomically diverse land snail genera in North America. The strigosa species complex from the Lower Salmon River in Idaho is the most diverse and polymorphic of all species within *Oreohelix* as it contains 12 described forms/subspecies and potentially many undescribed species. Wildlife diversity officials are hesitant to designate and develop conservation plans for new species or subspecies of *Oreohelix* without detailed taxonomic and geographic information, despite many of them being considered S1 rank or "of the greatest conservation need" to the Idaho Department of Fish and Game. A comprehensive survey of the genetic diversity of described and undescribed *Oreohelix* species is the first step to determine the taxonomic status of this group and whether conservation action is needed at the assemblage, species, and subspecies level. To resolve species level relationships within this group, we used a reduced representation genomic approach to summarize the information content of entire genomes to a manageable level, while still maintaining patterns of genetic variation at individual genome sites (i.e., loci). With this approach, called restriction enzyme associated DNA sequencing (RADseq), we sequenced approximately 30,000 restriction enzyme associated DNA (RAD) markers per species to construct a fully-resolved phylogenetic tree of the strigosa species complex. During our investigation, we discovered high levels of shared RAD genotypes (i.e., shared genetic variation) between described and tentative undescribed forms, which may indicate recent introgression between species and ongoing hybridization. Future work on this project will seek to disentangle the biogeographic hypotheses related to hybridization and ancestral colonization in this remarkably diverse system.

PROUSE, CODY*, Idaho State University/ IDFG, E. Freeman, M. Pacioretty and Z. Lockyer. Idaho Department of Fish and Game, Pocatello, Idaho 83204. **WILDLIFE UTILIZATION OF RUSSIAN OLIVE GROVES ON THE STERLING WILDLIFE MANAGEMENT AREA.**

Russian olive trees (*Elaeagnus angustifolia*) are a non-native species of tree that have come to dominate portions of the Sterling Wildlife Management Area near Aberdeen, Idaho. In order to determine the extent to which *E. angustifolia* is utilized by wildlife, both native and non-native species, and hunters in the area, we placed trail cameras in four plots with differing Russian olive treatment types to monitor use by wildlife. We are interested in usage differences between intact Russian olive stands, groves that had been cut and biomass had been left on sight, and groves where the biomass had been removed. Four cameras were placed at intact groves of *E. angustifolia,* two viewing clearings within the groves to target those animals entering and exiting, and two were set to view the understory. Two cameras were placed in an area in which Russian olives had been cut down and had the stumps treated to prevent regrowth, but had substantial biomass piled at the treatment site, and one camera was placed in an area where the Russian olives and biomass had been completely removed. Point count surveys were conducted in each area within the sampling period, in ten minute intervals to document and identify all visible animals. While this effort is ongoing, preliminary results indicate *E. angustifolia* as a highly utilized habitat type found on the SWMA. The intact groves show a much higher animal usage and biodiversity compared to the other treatment types. The areas with biomass remaining show greater usage compared to areas in which Russian olive has been completely removed. This data should help inform managers when considering future habitat treatments and recreational opportunities within SWMA, and will help in the development of an SWMA Russian olive management plan.

SAGE, ABBY* and Neil Carter. Boise State University, Boise, ID 83706. **A SOCIAL-ECOLOGICAL APPROACH FOR EVALUATING LIKELIHOOD OF CONFLICT WITH GRIZZLY BEARS IN IDAHO AND MONTANA.**

Human-wildlife conflict is a widespread and complex social-ecological problem that has led to significant declines in wildlife species worldwide. Wildlife can pose risks to people on shared landscapes, such as through livestock depredation or damage to property. People often respond to these risks by lethally removing wildlife or modifying habitat to reduce wildlife use. Although a great deal of research has examined how risks from wildlife are influenced by habitat and behavioral characteristics, much less attention has focused on human acceptance of wildlife and associated risks. However, recent studies indicate that human acceptance could play an influential role in determining the spatial occurrence of high-risk species. We address this knowledge gap by evaluating the spatial overlap of habitat suitability and human acceptance for grizzly bears (*Ursus arctos*), a high-risk species, in the High Divide region of Idaho and

Montana. This region plays a crucial role in grizzly habitat connectivity between the Greater Yellowstone Ecosystem and the Crown of the Continent; yet human development is rapidl expanding the wildland-urban interface in the area. To assess human acceptance, we surveyed approximately 500 ranchers on their attitudes toward grizzlies. We will model the effects of both spatial (e.g. socio-demographic, land cover) and non-spatial predictors (e.g. experience with bears, trust of wildlife managers) on social acceptance for grizzlies. Based on model results, we will create a social acceptance map to overlay with an existing map of suitable grizzly habitat. Using a multi-criteria decision-making approach, we will rank areas of conflict likelihood based on the combination of social acceptance and ecological suitability. We will validate conflict likelihood rankings with a spatial dataset of known conflict locations. The results will identify and predict areas to focus attention for conservation easement purchases and educational outreach.

SANDERS, LINDSEY E.*[1], Karen Launchbaugh[2], Paul Makela[3], Andrew Meyers[1], David D. Musil[4], Shane Roberts[4], and Courtney J. Conway[5, 1]. [1] Idaho Cooperative Fish & Wildlife Research Unit, College of Natural Resources, University of Idaho, Moscow, Idaho 83844, [2] University of Idaho, Rangeland Center, [3] Idaho BLM State Office, Branch of Resources and Science, [4] Idaho Department of Fish & Game, [5] U.S. Geological Survey. **IDENTIFYING MECHANISMS UNDERLYING GREATER SAGE-GROUSE RESPONSE TO LIVESTOCK GRAZING.**

Livestock grazing is a ubiquitous land-use in rangeland ecosystems throughout Idaho and the western U.S. Despite the prevalence of grazing in the western U.S., its potential effects (both positive and negative) on vulnerable wildlife populations are not yet well understood. This is a particularly important line of inquiry for sagebrush-obligate species, such as the greater sage-grouse (*Centrocercus urophasianus*), which relies entirely on the sagebrush ecosystem throughout its annual lifecycle. Given that greater sage-grouse populations have declined range-wide and show negative responses to other forms of human disturbance, understanding how sage-grouse respond to livestock grazing is imperative if we hope to effectively manage the sagebrush ecosystem for this vulnerable species. We plan to evaluate the relative influence of four mechanisms by which livestock grazing could potentially affect greater sage-grouse demography via alteration of 1) vegetation communities and structure at multiple scales, 2) local predator community composition and abundance, 3) food availability for hens and broods, and 4) disturbance of nest and brood sites by cattle movements. These efforts are part of a long-term grazing experiment taking place at five study sites in southern Idaho. Our findings will inform future management decisions and efforts to conserve greater sage-grouse and other sagebrush-obligate species throughout the western US.

SCHREMPP, THOMAS V.[1,2], J. L. Rachlow[1], T. R. Johnson[3], L. A. Shipley[4], R. A. Long[1], J. L. Aycrigg[1], and M. A. Hurley[5]. [1]Department of Fish and Wildlife Sciences, University of Idaho, Moscow, Idaho 83844 USA; [2]Idaho Department of Fish and Game, Lewiston, Idaho 38501 USA; [3]Department of Statistical Science, University of Idaho, Moscow, Idaho 83844 USA; [4]School of the Environment, Washington State University, Pullman, Washington 99164 USA; [5]Idaho Department of Fish and Game, Boise, Idaho 83712 USA. **QUANTIFYING THE NUTRITIONAL LANDSCAPE FOR MOOSE: AN APPROACH FOR ASSESSING LARGE-SCALE CHANGES IN FORAGE.**

Forested lands in the western USA have undergone changes in management and condition that are resulting in a shift towards climax vegetation. These changes can influence the quality and quantity of forage for herbivores that rely on early-seral plants; however, methods to quantify large spatiotemporal change and their impact on population dynamics are lacking. To evaluate how management of forested landscapes might affect nutrition for Shiras moose (*A. a. shirasi*) at large spatial scales, we developed a sampling design to assess summer diet composition, forage quality, and forage quantity, and used these data in a modeling framework to assess diet selection and predict current and past forage quantity for moose across 21 game management units (GMUs) in northern Idaho. We evaluated diet composition using microhistological analyses of fecal samples and collected shrub samples for estimating digestible energy and digestible protein. Diet composition was corrected for digestibility, and we combined recent advances in remote sensing techniques with regularized regression to predict forage availability and assess diet selection. Finally, we combined forage models with change detection analyses to predict current and past (i.e., 1984) quantity of forage shrubs across northern Idaho and compared forage metrics to harvest-based indices of population trend and productivity for moose. Predicted quantities of forage shrubs varied markedly across the study area with generally higher values in the north relative to the south. The quantity of forage shrubs was estimated to have declined over the past 30 years in about half of the GMUs, with the greatest declines predicted for high-energy forage species. Our approach provides a methodological foundation that can be readily adapted to evaluate other changing landscapes, and our study highlights the importance of assessing how changes in land management across broad spatiotemporal extents affect wildlife and their habitats.

SMITH, IAN*, J. Rachlow. University of Idaho, Moscow, Idaho 83843, L. Svancara. Idaho Department of Fish & Game, Boise, Idaho, 83707 **MODELING THE RANGE-WIDE DISTRIBUTION OF PYGMY RABBITS AND OVERLAP WITH AREAS MANAGED FOR SAGE-GROUSE.**

Loss and degradation of sagebrush landscapes across the Western US has prompted large-scale land management aimed at conserving and restoring habitat for Sage-grouse (Centrocercus spp.), including designation of numerous types of habitat management areas (HMAs). The pygmy

rabbit (Brachylagus idahoensis) also is a species of conservation concern due to its obligate relationship with sagebrush, and our goal was to evaluate the degree to which grouse-focused HMAs also conserve pygmy rabbits. As a first step, we created an inductive species distribution model (SDM) for pygmy rabbits across their full geographic range. We acquired 17,905 records of pygmy rabbit presence from all range states, and after screening for reliability and independence, we used 9,853 records for the SDM. We used the program Maxent to build models of varying complexity incorporating a diversity of environmental factors representing topographic, vegetation, fire, climate, and soil characteristics. We evaluated variation in subsampling distances, background extents, and regularization multipliers to create a model with the best predictive ability. Environmental predictor variables were iteratively eliminated from model consideration, resulting in a parsimonious model that reduced the spatial and sampling biases. This SDM provides a foundation for evaluating overlap between pygmy rabbits and Sage-grouse HMAs. Additionally, the model of predicted habitat for pygmy rabbits can be used by land managers to prioritize locations for pygmy rabbit surveys and to identify areas for land management, conservation, or restoration efforts.

TEMPE REGAN, Jeremy Halka, Jessica Pollock, and Jay Carlisle. Department of Biological Science, Intermountain Bird Observatory, Boise State University, Boise, Idaho, U.S.A.

INTEGRATED MONITORING IN BIRD CONSERVATION REGIONS (IMBCR) IN IDAHO.

Integrated Monitoring in Bird Conservation Regions (IMBCR) is a large scale, collaborative effort to monitor avian populations across the extent of their western ranges using standardized point counts. Initiated in 2008, the IMBCR program is one of the largest avian monitoring programs in the United States and involves 13 states and 27 partners. IMBCR was initiated in Idaho in 2010 by Bird Conservancy of the Rockies, and the Intermountain Bird Observatory began leading the effort in 2011. Since then, an ever-increasing monitoring effort has occurred on US Forest Service, Bureau of Land Management, and special project area lands. In 2017, we conducted the greatest survey effort in Idaho to date. Each survey transect consisted of a grid of 16 points. At each point, we conducted a six minute point count and recorded all birds seen or heard, as well as distance and time of detection. We conducted 278 surveys on nine national forests and 12 BLM Field Offices as well as three special project areas. We surveyed 81 grids on Regions 1 USFS lands, 45 grids on Region 4 USFS land, and 154 grids on BLM and special project areas. Overall, we detected a total of 179 species in Idaho in 2017; 8,940 bird detections of 98 species on Region 1 USFS, 10,831 bird detections of 138 species on Region 4 USFS, and 20,957 bird detections of 162 species on Idaho BLM lands and special project areas. We detected three new bird species in Idaho including Juniper Titmouse (Baeolophus ridgwayi), Pinyon Jay (Gymnorhinus cyanocepahlus), and Lark Bunting (Calamospiza melanocorys). As part of the IMBCR program, Bird Conservancy of the Rockies provides density and occupancy estimates

and species range maps by national forest, BLM field office, and other areas of interference on the Rocky Mountain Avian Datacenter website.

TURNER, HILARY A.[1], Renee Seidler[1,2]. [1]Idaho Department of Fish and Game, 4279 Commerce Circle, Idaho Falls, ID 83401. [2]Wildlife Management Institute, 4426 VT Route 215 N, Cabot, VT 05647. **IDENTIFYING WILDLIFE-VEHICLE COLLISION HOTSPOTS AND MITIGATION STRATEGIES: THE ROAD LESS TRAVELED IN IDAHO.**

Road ecology is an emerging frontier which is gaining momentum as researchers attempt to quantify the ecological consequences of roads. The Greater Yellowstone Ecosystem (GYE) is well known as one of the largest remaining intact temperate ecosystems in the world. Even so, it is fragmented by roads and other infrastructure, affecting ungulate and carnivore movement, migration, and dispersal. Wildlife-vehicle collisions (WVCs) are an often grossly underreported impact of roads on wildlife because injured animals can move off the road and die, unnoticed. US Highway 20 (US 20) runs through Yellowstone National Park, as well as the surrounding GYE, including Island Park, Idaho. To better understand the impacts of this road on wildlife in Island Park and provide optimum mitigation solutions, the Idaho Department of Fish and Game (IDFG) is conducting roadside carcass surveys, which began in December 2017. To conduct these surveys, an observer travels every other day on US 20 and State Highway 87 between Chester, Idaho and the Montana state line. When a carcass is found, the animal is identified, aged, and sexed, a GPS point is taken, and the carcass is removed from the road. If a mule deer is encountered, lymph nodes are taken and sampled for chronic wasting disease. In two months, we have recorded 36 carcasses of 14 taxa in the survey area. The data collected in this survey will supplement the existing roadkill database, help identify data deficits and roadway mortality hotspots, inform state agencies in their efforts to mitigate wildlife vehicle collisions, and help IDFG to streamline similar efforts statewide. Such data also help IDFG and Idaho Transportation Department better understand the economic impacts of WVCs (e.g., antlered ungulates are more valuable) when they consider cost-benefit analyses for mitigation efforts. Removing carcasses from the road prevents scavengers from also being hit and reduces roadway hazards. The ultimate goal of this work is to identify areas of potential mitigation such as crossing structures and fencing that can maintain or improve habitat connectivity to benefit wildlife, sportsmen and women, and motorists alike.

YORK, K.J.*[1], Johnson, T.N.[2], Ellison, M. J. [1,3]. [1]Department of Animal and Veterinary Science, University of Idaho, 875 Perimeter Dr. Moscow, ID 83844. [2]Department of Fish and Wildlife Sciences, University of Idaho, 875 Perimeter Dr. Moscow, ID 83844. [3]University of Idaho Nancy M. Cummings Research, Extension, and Education Center, 16 Hot Springs Ranch Rd. Carmen, ID 83462. **IMPLICATIONS OF GRAZING UTILIZATION LEVELS ON GREATER SAGE-GROUSE HABITAT IN CENTRAL IDAHO MESIC MEADOWS.**

Livestock management in mesic meadow pastures is of interest to industry, range managers, and conservationists because of the need to understand how best to accommodate livestock and wildlife. Greater sage-grouse (Centrocercus urophasianus) often use meadow pastures as brood-rearing habitat because of the availability of dietary forbs and insects, which are critical for juvenile sage-grouse survival and population maintenance. Understanding how grazing affects forbs that are important to sage-grouse can help develop management regimes that are effective for both livestock forage production and sage-grouse habitat. This research addresses whether and how varying rates of livestock grazing utilization influences habitat and resource availability in meadow pastures that are potential brood-rearing habitat for sage-grouse. Bred heifer cattle (n = 75) were stratified by body weight into six mesic meadow pastures (~ 5.5 ac; n = 25, 20, 15, 20, 5, or 0), where stocking rates created a gradient of grazing utilization levels, and grazed for 25 d in July 2017. Data were collected in each pasture < 3 wk pre-grazing, < 1 wk post-grazing, and after an 8 wk regrowth post-grazing period to investigate the effects on availability and condition of preferred forbs and habitat characteristics, including measures of vegetation composition and structure, biomass, and grazing utilization level. Individual cattle body weights were measured at the beginning and end of the grazing period to evaluate cattle performance. To identify sage-grouse use of the trial area, pellet counts were conducted in each pasture. Preliminary data from the first year of a multi-year study include: 1) pre- and post-grazing cover and biomass of forbs preferred by sage-grouse, and regrowth rates of preferred forbs; 2) short-term changes in species composition of preferred forbs; 3) horizontal and vertical structure of vegetation and forb canopy cover; and 4) performance and growth of heifer cattle.

YOUNG, AARON*, T. Johnson, University of Idaho, Moscow Idaho, 83844. **JUNIPER REMOVAL IN SAGEBRUSH COMMUNITIES: IMPLICATIONS FOR SPECIES INTERACTIONS.**

Invasion by western juniper (Juniperus occidentalis) leads to fragmentation and alteration of sagebrush steppe and is a major consideration for managers concerned with the conservation of sagebrush-associated species. Recent efforts aimed at improving habitat for Greater sage-grouse (Centrocercus urophasianus) have involved reduction of juniper cover. However, for other species associated with sagebrush, effects of these management actions remain either untested or only partially understood. Little is known about small mammal communities in juniper-encroached sage habitats, and the use of these landscapes by aerial predators that influence sage-grouse individual and nest survival has not been explicitly examined. For managers, balancing the requirements of a range of taxa necessitates an understanding of not only how management actions may influence population density and community structure, but also the mechanisms driving these changes. Altered habitat may affect species interactions at different spatial, temporal, and management thresholds through changes in predator-prey dynamics or habitat selection. Our objective is to examine how bird, small mammal, and predator communities respond to juniper removal and to identify how interactions among species may affect population demography. The Bruneau-Owyhee Sage-Grouse Habitat Project (BOSH) is expected to remove juniper across 600,000 acres of sage-grouse habitat in southwest Idaho. To evaluate this management, we have initiated a four-year 'before-after control-impact' study to examine effects of juniper removal treatments on songbird and small mammal abundances and community structure. We will also evaluate site occupancy for corvid and raptor species to explore potential changes in landscape use for predators of both sage-grouse and songbirds. To address our objectives, we conducted songbird, small mammal, and raptor/corvid surveys within areas comprising three categories of juniper cover: 0-10%, 10-20%, and >20%. We present preliminary results from each of these surveys. One additional season of pre-removal surveys will be conducted, followed by two seasons of post-removal surveys.