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ABSTRACTS

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ADAMS, JENNIFER, Gardner, Colby, Dwire, Maggie and Lisette Waits. University of Idaho, Moscow, Idaho 83844, Mexican Wolf Recovery Program, Albuquerque, New Mexico, 87113. **GENETIC PEDIGREE RECONSTRUCTION FOR THE ENDANGERED MEXICAN WOLF**

Maintaining the genetic diversity and health of small, reintroduced populations is an important consideration for endangered species programs. Pedigrees are a useful way to monitor effective population size and genetic diversity in a population but can be difficult to determine in wild populations of wide-ranging species. Genetic pedigree reconstruction can ameliorate difficulties associated with determining accurate pedigrees for wild populations. The Mexican wolf *(Canis lupus baileyi)* is an endangered subspecies of wolf for which an accurate pedigree is central to the recovery plan. The Mexican wolf has been reintroduced to the wild since 1998 and ranges over 13,329 square miles. Mexican wolves trace their ancestry to seven individuals who founded the captive breeding colony, which makes genetic pedigree reconstruction more challenging due to the higher degree of relatedness between individuals. Multi-locus microsatellite genotypes at 22 loci were generated for 95% of the individuals captured in the wild. Mexican gray wolf origin was genetically confirmed for each individual using a Bayesian clustering method (STRUCTURE) and a reference database of Mexican wolves, Rocky Mountain wolves, coyotes and dogs. Individuals confirmed to be Mexican wolves were then separated into year of birth cohorts based upon estimated age at capture and were tested against all individuals of breeding age at the time of each breeding season. Pedigree assignments were made based upon the results from program CERVUS and corroborating field data. A total of 299 pedigree assignments were confirmed or established. All sampled individuals could be completely (both parents) or partially (1 parent) assigned to the pedigree. Reconstruction of the wild pedigree has allowed the Mexican gray wolf recovery program to better manage the reintroduced population to maintain genetic diversity.

ARKLE, ROBERT S. [1], David S. Pilliod[1], Justin L. Welty[1], Michelle I. Jeffries[1], Matthew J. Germino[1], Michael C. Duniway[2], David A. Pyke[3], John B. Bradford[4]
[1]U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Boise, ID 83706
[2]U.S. Geological Survey, Southwest Biological Science Center, Moab, UT 84532
[3]U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Corvallis, OR 97331
[4]U.S. Geological Survey, Southwest Biological Science Center, Flagstaff, AZ 86011. **SAGEBRUSH RESTORATION FOR GREATER SAGE-GROUSE HABITAT: IS ECOLOGICAL RESISTANCE AND RESILIENCE THEORY A USEFUL TOOL?**

The concept of ecological resistance and resilience to disturbance and subsequent invasion has become a cornerstone of conservation management in many ecosystems, including the Great Basin of the United States where fire and invasion by non-native plants have resulted in habitat loss, vegetation state changes, and threats to native species conservation. Resource managers utilize resistance and resilience concepts to prioritize areas for habitat conservation and habitat restoration, especially as they relate to the Greater Sage-grouse, a high-profile species of conservation concern. According to resistance and resilience theory, after disturbances such as wildfire, areas with cool-moist soil temperature regimes should be more resistant to cheatgrass invasion and more resilient, or better able to return to pre-fire vegetation conditions, than areas with warm-dry soil temperature regimes. However, whether this theory works in practice is largely untested at this spatial scale. We sought to assess whether resistance and resilience theory is supported by field data from over 200 post-wildfire rehabilitation sites sampled from 1–35 years post-treatment throughout the Great Basin. Specifically, we assess

whether resistance and resilience: 1) predicts the likelihood of reestablishing sage-grouse habitat, 2) predicts the rate of rehabilitation, 3) classes or sub-classes hold more predictive ability, 4) varies regionally in its predictive ability, and 5) predicts invasibility by species other than cheatgrass. Collectively, our preliminary findings may suggest whether spatial products based on this theory are likely to help inform habitat conservation and restoration decisions.

SORAIA BARBOSA[1], Kim Andrews[2,3], Amanda Goldberg[1], Digpal Singh-Gour[1], Bill Bosworth[4], Paul Hohenlohe[1], Courtney Conway[1] and Lisette Waits[1] [1]University of Idaho, 875 Perimeter Drive, Moscow, ID 83844 [2]NOAA Pacific Marine Environmental Laboratory, Seattle, WA, 98115 [3]University of Washington JISAO, John M. Wallace Hall, 3737 Brooklyn Ave NE, Seattle, WA 98105 [4]Idaho Department of Fish and Wildlife, 3101 S. Powerline Road, Nampa, ID 83686.

LANDSCAPE GENOMICS OF ADAPTIVE DIFFERENTIATION IN TWO SISTER SPECIES OF IDAHO GROUND SQUIRRELS

In this study we aimed at identifying neutral and adaptive differentiation between and within northern (NIDGS, *Urocitellus brunneus*) and southern (SIDGS, *Urocitellus endemicus*) Idaho ground squirrel species. For this, we performed RAD sequencing on DNA extracted from 101 NIDGS and 64 SIDGS cheek swab samples, obtaining a total of 5074 single nucleotide polymorphisms (SNPs) after filtering. We then tested for loci putatively under selection with two methods: one looking at population differentiation outliers and the other looking at genotype-environment associations. These analyses identified 50 outliers and 72 loci associated to either Elevation or Mean Diurnal Range (MDR) in temperature, which combined were considered 'adaptive'. From the remaining loci, those in Hardy-Weinberg equilibrium (4584 SNPs) were considered 'neutral'. We performed a Discriminant Analysis of Principal Components (DAPC) for both datasets, and a STRUCTURE analysis for the neutral dataset alone, and observed that there is a clear separation of NIDGS and SIDGS in both datasets, and further subdivision into two groups within each species. In NIDGS we detected that one population on the far-east of the sampled area, Mud Creek, is very distinct at adaptive loci from all other NIDGS. Our results show clear adaptive differences between the two ground squirrel species in terms of associations to Elevation and MDR. Within SIDGS, these differences are also observed possibly as a result of barriers to gene flow, but in NIDGS, were only detected at the adaptive level. We found that SIDGS population subdivision appears to be a result of isolation-by-distance, while in NIDGS genetic differences are mainly observed at the adaptive level, and could represent local adaptation of some population. We propose that such differences need to be considered for management plans that aim to protect evolutionary capacity.

KRISTA L., BIORN. Idaho Department of Fish and Game, Boise River Habitat District, Boise, Idaho 83716. **EIGHT YEARS LATER: AN UPDATE ON THE STATE HIGHWAY 21 WILDLIFE UNDERPASS PROJECT.**

In recent years, widespread concern has arisen over the increase in wildlife-vehicle collisions on State Highway 21 in Ada and Boise counties in southwestern Idaho. Each year, over 7,000 mule deer (*Odocoileus hemionus*) and 1200 elk (*Cervus elaphus*) must cross SH-21 as they migrate from their summer ranges to their wintering habitat at the Boise River Wildlife Management Area. While crossing the road, approximately 150 - 210 vehicle collisions with mule deer and 5 – 10 vehicle collisions with elk occur within a 22 mile stretch of the highway. Estimated annual cost of these collisions is $750,000 to $1,000,000. To reduce the risk of wildlife-vehicle collisions and maintain habitat connectivity, state agencies and private organizations began working together in 2007 to develop and construct the first retrofitted wildlife specific crossing structure in Idaho. This presentation will focus on this collaborative effort including - why an underpass was chosen for this location, how it was engineered and funded, why the process took so long, the effectiveness of the project, and future plans for the highway.

KRISTINA BOYD, Michael Lucid, and Evan DeHamer. Idaho Department of Fish & Game, Coeur d'Alene ID 83814. **PUBLIC PARTICIPATION IN THE HABITAT RESTORATION PROCESS**

The Idaho Department of Fish & Game is partnering with the Yellowstone to Yukon Conservation Initiative in 2018-2019 to restore 250 acres of lowland forested habitat on the Boundary Smith Creek Wildlife Management Area north of Bonners Ferry, ID. The collaborative project is called the Idaho Panhandle Bees to Bears Climate Adaptation Project. Its education and outreach component focuses on imperiled pollinators, including the Western bumblebee (*Bombus occidentalis*), Suckley's cuckoo bumblebee (*B. suckleyi*), and monarch butterfly (*Danaus plexippus*). Public inclusion in restoration activities involves bumblebee surveys and native seed collection and planting of pollinator-preferred species. The process of public participation in field projects presents significant benefits and challenges. We present the first year challenges we encountered and the solutions we have developed for them. We also present a summary of public contributions to the project and their significance to the habitat restoration funding and implementation process.

BRUSKOTTER, JEREMY; Slagle, Kristina; George, Kelly; and Robyn Wilson.
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ATTITUDES TOWARD WOLVES, COYOTES AND THE FEDERAL ENDANGERED SPECIES ACT IN THE WEST AND BEYOND

We conducted a survey of U.S. residents (n=1287) across three regions with different experiences in conserving gray wolves—i.e., the northern Rocky Mountains, western Great Lakes, and the rest of the U.S. The survey assessed support for the Endangered Species Act (ESA), trust in the U.S. Fish and Wildlife Service (FWS), and attitudes toward wolves and coyotes across three regions with different experiences in conserving gray wolves through the ESA. We also conducted a literature review to identify other published studies that documented support for the ESA and/or attitudes toward wolves (or coyotes) at the national level. We found: (a) ~4 in 5 Americans expressed support the ESA, and ~1 in 10 oppose; (b) support for the ESA remained stable over the past two decades; (c) strong majorities (>2/3rds) of individuals identifying with 8 special interest types (including hunters, farming/agriculture, and conservation) support the ESA; (d) no differences in support for the ESA, attitudes toward wolves, or trust in the FWS across study regions; and (e) > 40% increase in the proportion of individuals expressing positive attitudes towards both wolves and coyotes at the national level. Results are discussed in light of shifting values concerning wildlife conservation.

BYRNE, MORGAN* (Gonzaga University, Spokane, WA, 99258), David Leptich (Idaho Fish and Game), Stephen Hayes (Gonzaga University) **ARE EGG MEMBRANES EQUIVALENT OR BETTER THAN EGGSHELLS FOR BIOMONITORING WETLAND POLLUTION?**

Wetland habitats in the lower Coeur d'Alene Basin are contaminated with historic mine waste, including lead (Pb), cadmium (Cd), and zinc (Zn). Previous work has shown that the amount of Pb in wood duck eggshells is positively related to adjacent wetland Pb levels, indicating that wood duck eggshells may be a valuable biomonitoring tool. However, collecting and isolating shells from other nest box contents is time consuming. The objective of our study was to compare eggshells and membranes as a biomonitor for environmental Pb in wetlands. Previous authors have suggested that the developing embryo recruits calcium ions (Ca^{++}) from the shell during incubation. It is also well-documented that Pb^{++} ions mimic Ca^{++} in many biochemical reactions. Therefore, we hypothesized that Pb, when present in eggshells, is also recruited into the embryo from the shell during embryonic development. If our hypothesis is correct, we predict that membranes from Pb-contaminated wood duck eggshell membranes will also be contaminated. We visited 150 wood duck nest boxes in the lower Coeur d'Alene Basin during June – August 2018. We collected 32 paired shell and membrane samples from nest boxes adjacent to Pb-contaminated wetlands. For each nest, we separated shells and membranes and treated them as a paired-sample unit. We estimated Pb concentration with inductively-coupled mass spectrometry (Anatek Labs, Inc. in Spokane, WA). We used equivalence tests to compare mean Pb concentrations in shells and membranes. We will also compare variance estimates between shells and membranes because it's possible one sample type may provide a more precise estimate of wetland Pb concentration than the other. If we conclude that one sample type has less variation in Pb and a higher concentration of Pb, then this sample type will identify the most promising biomonitoring tool for wetland pollution.

Andrews, Kimberly[1], Erin Landguth[2], FRANCES CASSIRER[3], Hollie Miyasaki[4], and Lisette Waits[1]. [1]University of Idaho, Moscow, ID 83844; [2] University of Montana, Missoula, MT 59812; [3]Idaho Dept. of Fish and Game, Lewiston, ID 83501; [4]Idaho Dept. of Fish and Game, Boise, ID 83712 **DO GENETIC PROFILES OF RESTORED BIGHORN SHEEP POPULATIONS REFLECT TRANSLOCATION HISTORY?**

Since 1922, over 21,000 wild sheep have been translocated within and among states and provinces in western North America for species restoration (Western Association of Fish and Wildlife Agencies Wild Sheep Working Group). In Idaho, bighorn sheep (*Ovis canadensis)* have been translocated since the 1960's from 5 states and provinces including Oregon, Wyoming, Montana, Alberta, British Columbia, and within Idaho. Several sources are often used to reestablish a single population to increase numbers and genetic diversity. As a result, despite small founder sizes, many of Idaho's reintroduced populations have similar or greater allelic richness than native populations. However, it is unknown whether translocated individuals from different source populations contribute equally to numbers and genetic diversity. We used 10 neutral microsatellite markers to empirically evaluate the genetic composition of restored populations in Idaho, and their sources. We then simulated the expected present-day genetic composition of the re-established populations, under the assumption that translocated individuals from each source population performed equally. By comparing the empirical genetic data with the simulation results, we evaluated whether the assumption of equal fitness across translocation sources was violated, and therefore whether certain source populations were more successful than others. This analysis could help inform decisions to increase the success of future translocations.

CALTON, TOM* and Donna Delparte, Idaho State University, Pocatello, Idaho 83209.
UTILIZATION OF UAVS FOR FINE SCALE VEGETATION MAPPING OF CSTG HABITATS

Columbian Sharp-tailed Grouse (*Tympanuchus phasianellus columbianus* CSTG) populations have been in decline since the turn of the 20th century. CSTG rely on a diversity of vegetation communities for all life stages. Female nest site selection is dependent on available vegetation and corresponds to sites with a dense shrub cover of species such as rabbit brush (*Ericameria spp.*) and sage (*Artemisia spp.*). Management decisions about habitat restoration demand an increasing level of accurate and precise data. As funds are limited, it is imperative to employ cost effective and time saving methods for data collection, while at the same time increasing the amount of data available to researchers and managers to make the best possible decisions. Small Unmanned Aerial Systems (sUAS) are improving the ability to capture high spatial resolution data concerning wildlife habitats at a relatively inexpensive price. By using a multi-copter sUAS fitted with a natural color digital camera and a multi-band hyperspectral sensor, we are able to map vegetative characteristics including structure, density, and composition. The high resolution in the data collected allows classifications of vegetation at a very fine scale. By introducing the use of sUAS for mapping fine scale vegetation composition, this innovative approach will explore the functionality of this technology for developing a greater understanding of habitat functions and usage.

HEATHER CLENDENIN*,1,2 Jennifer Adams,1 David Ausband,3 Jim Hayden,3 Paul Hohenlohe, 2 and Lisette Waits1Departments of 1Fish and Wildlife Sciences and 2Biological Sciences: Bioinformatics and Computational Biology, University of Idaho; 3Idaho Department of Fish and Game. **FINDING LITTERS AMONG THE HARVEST: GENETIC RECONSTRUCTION OF GRAY WOLF SIBLING GROUPS USING MICROSATELLITES AND SNPS**

Identifying unique litters among harvested gray wolf (*Canis lupus*) young of the year (YOY) can provide an estimate of the minimum annual number of reproductive pairs as well as a useful metric for assessing distribution of harvest pressure across packs. Based on microsatellite genotype data, we generated a reliable estimated count of unique litters by reconstructing sibling groups among YOY harvested in Idaho. However, we found that the ability to discern between closely related non-siblings was diminished when the number of loci was reduced from 18 to 10. To further explore the impacts of different genotype data, we used RADseq to identify thousands of single nucleotide polymorphism (SNP) loci and repeated sibship analyses for 50 gray wolf YOY from 2014. Our results indicated that sibship analyses using SNP loci may be limited by missing data caused by DNA quality and quantity, and that strict filtering may yield inconsistent results. SNP and microsatellite datasets were generally concordant, but produced some discrepancies in sibship assignments. To compare SNP-based sibship estimates against known relationships, we have also generated RADseq-derived SNPs in an analogous group of 86 red wolf (*Canis rufus*) YOY of known pedigree. Though the use of SNPs is increasing in genetic monitoring of wildlife, the strengths and trade-offs of these approaches—especially when working with legacy data sets or lower-quality DNA—should be considered in transitions to next generation methods.

ARIANA DICKSON*, Boise State University, Boise, Idaho, 83725. Jim Belthoff, Boise State University, Brian W. Smith, U.S. Fish and Wildlife Service, Zachary Wallace, Wyoming Natural Diversity Database, Matt Stuber, U.S. Fish and Wildlife Service, Mike Lockhart, Wildlands Photography and Bio-Consulting, and Todd Katzner, U.S. Geological Survey. **NON-TARGET EXPOSURE OF RAPTORS TO TOXINS: LIVE SAMPLING FOR ANTICOAGULANT RODENTICIDES IN FERRUGINOUS HAWKS**

Anticoagulant rodenticides (ARs) threaten birds of prey through unintentional secondary poisoning, especially in species that focus their diet on rodents. Exposure to ARs in free-living raptor populations has been documented on at least three continents, but patterns and pathways of exposure are not well studied. Thus, potential effects of ARs on raptor populations remain difficult to quantify and mitigate. We evaluated the risk of AR exposure to Ferruginous Hawks (*Buteo regalis*) in southwestern Idaho and southern Wyoming. These hawks inhabit shrub-steppes, grasslands, and deserts, many of which are modified by agriculture, wind power, and oil

and gas development. Rodenticides are often deployed in these areas to reduce populations of burrowing mammals such as ground squirrels (*Urocitellus* spp.) and prairie dogs (*Cynomys* spp.), species that make up a large proportion of Ferruginous Hawk diet. We collected blood samples from 165 Ferruginous Hawk nestlings from 56 nests in Idaho and Wyoming and evaluated the prevalence and concentrations of eight different ARs. Every type of AR has the same mode of action: they deplete clotting factors over time and increase clotting time. Thus, we also measured blood clotting times (metrics: international normalized ratio [INR] and prothrombin time [PT]) of hawks in the field using technology originally designed for use in humans. We evaluated this field test kit for potential use on non-human animals and the rapid assessment of AR toxicity in raptors. Preliminary data suggest that AR exposure in the nestling hawks we sampled was low. We also discuss the degree to which coagulation assays designed for humans may be useful for raptors, the use of prothrombin time as a biomarker for ARs, and the challenges of blood sampling for AR residues.

EHLEN, LAURA*, K. Vierling and L. Svancara. University of Idaho, Moscow, Idaho 83843.
FACTORS INFLUENCING NEST MICROCLIMATE FOR GRASSLAND BIRDS IN SHRUB-ENCROACHED WET PRAIRIE SYSTEMS.

Shrub encroachment can alter both abiotic and biotic processes within grassland communities. We assessed the role of vegetation characteristics on artificial nest temperatures in a grassland community experiencing shrub encroachment. Artificial nest temperature data (n= 78) were collected on the Weippe Prairie in Clearwater county in Idaho across 2 years (2017 and 2018) during the bird breeding season (May-July). We used temperature loggers placed inside artificial nests to assess how nest temperature changed with shrub and nest-site vegetation characteristics. Artificial nests were placed along a transect that radiated from a focal shrub; artificial nests were placed along that transect immediately under the shrub and then at varying distances up to 20m from the focal shrub. We modeled average daily minimum and maximum temperatures as a function of distance from shrub, focal shrub height, herbaceous canopy cover at the nest, herbaceous plant height at nest, sampling period, and year. We used a mixed modeling approach and evaluated the top models using a multiple model selection approach. Fifty percent of artificial nests in this study experienced temperatures above 40°C for at least an hour, and temperatures above this value typically are lethal for developing avian embryos. The absolute maximum temperature (hereafter Tmax) recorded in artificial nests in both years was above 57° C and the absolute minimum (hereafter Tmin) in both years was low (<5° C). Year, distance from focal shrub and plant height were the variables that influenced Tmax the most. Tmax was lower in 2017, increased as distance from the focal shrub increased, and was lower as herbaceous plant heights at the nest site increased. Similarily, year also influenced Tmin, which decreased as distance from the focal shrub increased. This study provides baseline data on shrub effects on microclimates in a grassland community that can affect bird reproductive activities.

FORBEY, JENNIFER SORENSEN[1]and Brecken Robb[1]. Boise State University, Boise, Idaho 83725. **AN ACADEMIC'S "CURE" FOR SUSTAINABLE WILDLIFE RESEARCH: HOW COURSE-BASED UNDERGRADUATE RESEARCH EXPERIENCES (CUREs) CAN HELP MONITOR WILDLIFE AND RECRUIT FUTURE WILDLIFE BIOLOGISTS**.

Challenges facing the future of wildlife research include a reduction in funding to support research, collection of more complex and larger data sets, and relatively low recruitment and retention of a diverse and skilled workforce. We demonstrate how Course-Based Undergraduate Research Experiences (CUREs) within the undergraduate curriculum can provide a potential solution for these challenges. We used CUREs to integrate physical specimens of wildlife donated by hunters, collaboration with wildlife managers, and student driven physiological experiments in the classroom to train and recruit future wildlife biologists. We show how a diverse workforce of classroom scientists can be used to generate longitudinal data to monitor the health of wildlife, generate and test novel hypotheses, and share results with the broader scientific community. CUREs used in large enrollment classes provide more extensive training for and recruitment of a diverse student population than do intensive summer research or internship experiences. CUREs provide a broader range of students with knowledge and research skills to think critically about science, wildlife populations, management agencies, and society and better prepare them for wildlife careers. CUREs provide faculty greater access to a diverse workforce to help generate and analyze data, while simultaneously meeting teaching requirements. Finally, CUREs help the wildlife profession by increasing the recruitment and retention of a more diverse and trained workforce capable of advancing the understanding, conservation, and management of wildlife.

PATRICK D. GILTZ*, Charles R. Peterson, and Ken A. Aho. Department of Biological Sciences, Idaho State University, Pocatello, Idaho 83209-8007.
MODELING THE NUMBER OF CROWDSOURCED ANIMAL OBSERVATIONS TO DETECT SPECIES CONSERVATION PROBLEMS

Can crowdsourced animal observations (presence only data with no underlying sampling design) be used to detect changes in populations? Our objective is to understand the factors influencing observations contributed to the Idaho Amphibian and Reptile iNaturalist Project. We have analyzed over 1500 observations from the project and are developing a statistical model based on ecological and social factors that may affect the number of observations in different areas of the state. The dependent variable is observations per hexagonal mapping unit. Independent variables include species richness (from Idaho GAP analysis), an index of human impact on habitat, and human population per hexagon. We evaluated 14 candidate models under a generalized linear model approach. The models included all combinations of independent variables, quadradic terms for curvilinear relationships, and terms representing interactions. We used the Akaike Information Criterion (AIC) to determine the most parsimonious model. The optimal model for the number of observations per hexagon included species richness and human impact and used a negative binomial error distribution with a log link function. Our goal is to use fitted values generated by the model to compare with the actual pattern of future observations received to detect potential population problems.

HARJU, SETH, Heron Ecological, LLC, Kingston, Idaho, 83839
C. Olson (HWA Wildlife Consultants, Laramie, WY) and S. Cornell (Meeteetse Conservation District, Meeteetse, WY) **MOVEMENT OF BREEDING AND NON-BREEDING RAVENS, RAVEN NEST REMOVAL, AND GREATER SAGE-GROUSE NEST SUCCESS**

Common ravens (*Corvus corax*) are quickly becoming a widespread wildlife management concern as they are both subsidized by human activities and can have strong negative impacts on species of conservation concern. We conducted a raven and greater sage-grouse (*Centrocercus urophasianus*) study in northwestern Wyoming involving: 1.) GPS units to determine movement behaviors of breeding and non-breeding ravens and sage-grouse, 2.) monitoring raven movement after experimental removal of raven nests, and 3.) monitoring sage-grouse nest success in areas with and without raven nest removal. We found that breeding ravens and breeding sage-grouse showed crepuscular movement patterns whereas nonbreeding ravens showed minimal diurnal variation in movement rates. Following removal of active raven nests, we found that breeding ravens dramatically switched to high and variable movement rates whereas untreated breeding ravens showed regular movement until fledging over the same time period. We also found that sage-grouse nest success was 2-5 times higher in portions of the landscape where raven nests were removed than in the same landscape where raven nests were untreated, but only in our study area with previously-documented high rates of raven predation on sage-grouse nests. In our study area with previously-documented high rates of both coyote and raven depredation, we found no impact of raven nest removal. These results suggest that where ravens are primary sage-grouse nest predators, raven nest removal may improve sage-grouse nest success via switching how ravens use space and forage on the landscape.

HAYES, HEATHER M.[1], R. A. Miller[1], J. D. Carlisle[1], and C. E. Moulton[2]. [1]Intermountain Bird Observatory, Boise, Idaho 83725, and [2]Idaho Department of Fish and Game, Boise Idaho, 83712. **LONG-TERM MONITORING OF THE SHORT-EARED OWL (ASIO FLAMMEUS) IN THE INTERMOUNTAIN WEST: HOW CITIZEN SCIENCE CONTINUES TO EXPAND THE BOUNDARIES OF CONSERVATION RESEARCH**

The Short-eared Owl is an open-country species that breeds in the northern United States and Canada, and has likely experienced a long-term, range-wide population decline. However, the cause and magnitude of the decline are not well understood. Believed to be the largest of its kind in the world, the Western Asio flammeus Landscape Study (WAfLS) was developed as a broad-range landscape survey to address 4 main conservation objectives for this species: 1) better define and protect important habitats; 2) improve population monitoring; 3) better understand owl movements; and 4) develop management plans and tools. This project engages enthusiastic citizen-scientist volunteers across the west to gather critical survey data, enabling a rigorous assessment of the status of this species. Now in its fourth year, the scope of this successful citizen-science model has grown to encompass 8 western states and project recruitment has swelled to over 600 participants consisting mostly of citizen volunteers but also includes volunteer professional biologists. This expansion was critical in providing a much larger lens in which to view not only Short-eared Owl population estimates, but also trends in these population estimates over time and their correlation with habitat and climate. Results from this long-term monitoring project have and will continue to directly influence high-value conservation actions by state and federal agencies, and volunteers are rewarded with training and experience in critical observation, the scientific method, and data collection, regularly reporting unique and exciting observations.

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Deanna H. Olson, *U.S.D.A. Forest Service, Pacific Northwest Research Station, Forestry Sciences Laboratory, 3200 SW Jefferson Way, Corvallis, OR, 97331, USA* **AN ANALYSIS OF SNAKES AND LIZARDS UNDER THE CONSERVAATION UMBRELLA OF THE GREATER SAGE-GROUSE.**

Umbrella species are recognized as those species whose conservation will benefit others based on the axiom that protecting and managing habitat for species of greatest conservation need will also benefit other species occurring within their range. Conservation efforts for the Greater Sage-grouse (*Centrocercus urophasianus*) in the vast sagebrush ecosystems of western North America represent an unprecedented restoration effort for terrestrial ecosystems. Many actions are touted as also beneficial to other wildlife yet few studies have assessed potential effects to non-target species. Snakes and lizards (Order Squamata) are particularly diverse in these arid and semi-arid regions, but under-studied and the recipients of far fewer conservation efforts. This disparity motivated us to investigate whether these species might secondarily benefit from the conservation umbrella provided by management actions targeting the Greater Sage-grouse. Using existing data, we first assessed what species are likely to co-occur with sage-grouse because of overlapping ranges, distributions, and shared habitat associations. We then evaluated which of these species might be affected by management for sage-grouse. Our preliminary results show that 35% (64 of 185) of squamate species in the western United States occur within the range of the Greater Sage-grouse. About a third (11 snake and 11 lizard species) of these 64 species have more than 10% of their distributions within the range of sage-grouse. Habitat similarity indices revealed that 14 of these 22 species (8 snake and 6 lizard species) shared sufficient habitat associations with sage-grouse that they might benefit from habitat management actions intended for sage-grouse. Conversely, preliminary results indicated that the remaining 8 of 22 species may not benefit from or may be negatively affected by sage-grouse habitat management actions. Since 1990, we estimate that about a third of all land treatments on public land within the range of the sage-grouse are conducted for grouse, at least partially, spanning several million hectares. Our assessment indicates that at least 14 squamate species could benefit from the sage-grouse conservation umbrella – a number higher than previously estimated – but additional research on each species' responses to habitat restoration techniques are needed to assess broader claims of multi-taxa benefits of sage-grouse habitat management.

JOHNSON, BRITTANI, D. Newman and G. Painter. Department of Idaho Fish and Game, Salmon, Idaho 83467. **EFFECTIVENESS OF IDAHO FISH AND GAME DEPREDATION HUNT PROGRAM ON EAGLE VALLEY RANCH IN SALMON, IDAHO.**

Eagle Valley Ranch, located in the Bohannon Creek watershed near Salmon, Idaho, has a history of aggregate elk depredation on irrigated grass, alfalfa fields, stored hay, and rangeland. Generations of elk that summer in Montana have learned the ranch is a refuge for fall, winter, and spring range use. Prior to 2001, 100-300 elk were observed on and off the ranch between September and March. The landowner allowed public hunting, and most elk were dispersed

across public lands adjacent to the ranch. Following sale of the ranch in 2001, the new landowners allowed little elk hunting, and the Department was unsuccessful in gaining needed public access for antlerless elk hunting to address the growing herd and refuge situation. Local sportsmen expressed concern over lack of access to the public resource. In 2014, the number of elk on the property reached 1,250, and the ranch owners agreed action was needed to address the growing number of elk and forage loss. They met with Department staff in 2015 to develop a depredation hunting program that would utilize the public to apply consistent and directed hunting pressure to herds on the ranch. The Department implemented a pilot program in 2015 and 2016, then implemented a full public hunting program in 2017 and 2018. Ranch and Department staff began seeing less elk and forage loss, and public hunters showed enthusiasm to hunt the ranch. GPS collar data and elk ground surveys showed the effectiveness of consistent and directed hunting pressure on elk in the 2017 and 2018 hunting programs. Fewer elk were being harvested and observed on the ranch, and more observed and harvested on adjacent public lands. Department staff and the Eagle Valley Ranch landowner and manager met in January 2019. They agreed to continue the program, and future collaboration will continue.

KRISTOF, ANDREA and Brian Wehausen. Camas National Wildlife Refuge, Hamer, Idaho 83425. **RESTORING RESILIENCY TO HIGH DESERT WETLANDS IN THE FACE OF DECREASING WATER AVAILABILITY: THE CAMAS CREEK RESTORATION.**

Camas National Wildlife Refuge encompasses nearly 11,000 acres of high desert in southeastern Idaho. The refuge was established in the 1930s at a time when 3,000+ acres of wetlands supported a significant amount of waterfowl production, supplied valuable stopover habitat for tens of thousands of migratory waterbirds, and provided year-round habitat for resident obligate species. However, changes in land use and climate have depleted both the surface and ground water supplies available to the refuge. Correspondingly, the habitat available to migratory waterbirds has significantly decreased and over-wintering habitat for resident obligate species has all but disappeared. The infrequent inundation of many areas challenges the integrity and persistence of these wetlands, which are critical to the executive order under which the refuge was established. Therefore, the refuge is planning to restore geological, topographical, and hydrological elements of the landscape, and to strategically reconfiguring infrastructure in order to most efficiently translate increasingly limited water resources into quality wetland habitat. One component of this project is the restoration of Camas Creek from an excavated and incised channel to a shallow stream more reminiscent of its native state. This will promote overbank flooding and slow water velocities, which will in turn increase the quantity and quality of surface water retained on the refuge. We anticipate that the more abundant and less sediment laden water from a restored Camas Creek will contribute to the recovery of historical wetland acreage lost to annual weeds, and to the increased production of high quality aquatic resources for migratory waterbirds.

LACHMAN, DEO*[1], C. Conway[2], K. Vierling[1], and T. Matthews[3]. [1]Department of Fish & 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; [3]Minidoka National Wildlife Refuge, Rupert, Idaho 83350. **FACTORS AFFECTING NEST SURVIVAL OF WESTERN GREBES**.

Western Grebes (*Aechmophorus occidentalis*) are colonial nesting waterbirds that have experienced a dramatic population decline. Our objective was to explore a non-invasive technique for estimating nest survival and to identify the factors that influence nest survival. We conducted our study at Cascade Reservoir in Cascade, Idaho which is home to the largest grebe breeding colony in Idaho. We used a small unmanned aerial system (drone) to map and monitor the grebe colony during the breeding period. We conducted six flights between June 10 – July 11, 2018 and used the photographs from each flight to create an orthomosaic image that we then digitized and georeferenced. The resolution of the images allowed for visualization of the nest, nest contents, and adult grebes. We created nest histories and estimated nest fate for 709 grebe nests. We collected data on the following covariates to assess whether any of them affected nest survival: distance of the nest to the center of the colony; distance of the nest to the edge of the colony; distance of the nest to deep water habitat; water depth at the nest; nearest neighbor distance, and an aggregation index that is the mean of the five nearest neighbor distances. We used program MARK to estimate daily survival probabilities for each nest and AIC to select among 60 candidate nest survival models. Of the 709 grebe nests, 45.2% were successful. The daily survival probability of grebe nests was positively correlated with water depth at the nest and the aggregation index. Daily survival probabilities were negatively correlated with distance between the nest and the colony center and distance to deep water habitat. The results of this study can be used to inform conservation efforts by identifying areas of the colony that are most vulnerable and formulating management recommendations to increase nest survival.

LOONAM, KENNETH* University of Montana Missoula, MT 59801, D. Ausband. Idaho Cooperative Fish and Wildlife Research Unit, P. Lukacs. University of Montana, M. Mitchell. Montana Cooperative Wildlife Research Unit, H. Robinson. Panthera. **TIME-TO-EVENT DENSITY ESTIMATION OF LOW-DENSITY SPECIES WITH REMOTE CAMERAS**

Abundance estimates can inform management policies and are used to address a variety of wildlife research questions, but reliable estimates of abundance can be difficult and expensive to obtain. For low-density, difficult to detect species, such as cougars (Puma concolor), the costs and intensive field effort required to estimate abundance can make working at broad spatial and temporal scales impractical. Remote cameras have proven effective in detecting these species, but the widely applied methods of estimating abundance from remote cameras rely on some portion of the population being marked or uniquely identifiable, limiting their utility to populations with naturally occurring marks and populations that have been collared or tagged. Methods to estimate

the abundance of unmarked populations with remote cameras have been proposed, but none have been widely adopted. The time-to-event model proposed by Moeller et al. (2018) estimates abundance using observed encounter rates at randomly or systematically placed cameras to estimate abundance. Working with Idaho Department of Fish and Game, we estimated the abundance of two cougar populations using the time-to-event model. While limited by sampling assumptions, the time-to-event model is a promising method for estimating the abundance of unmarked, low-density populations. Future work will compare this method with estimates of cougar abundance obtained from genetic spatial capture-recapture.

PANTING, BRETT[1], E. Gese[2], M. Conner[2], and S. Bergen[1]. Idaho Department of Fish and Game, Idaho Falls, Idaho 83401[1] , Utah State University, Logan, Utah 84322[2]. **RABBITS PRODUCING PRONGHORN? A LOOK AT ENVIROMENTAL CONSTRAINTS ON PRONGHORN NEONATES ACROSS IDAHO.**

Pronghorn were studied in three separate and distinct study areas, the Big Desert, Camas Prairie, and Little Lost and Pahsimeroi valleys. We captured and VHF-collared pronghorn fawns found in our three study areas. Fawns were monitored daily with telemetry equipment for survival. Field necropsies were performed to determine cause of death for each fawn. The highest cause of mortality on fawns was coyotes (*Canis latrans*). Other predators on pronghorn fawns were bobcats (*Lynx rufus)*, golden eagles (*Aquila chrysaetos*), and black bear (*Ursus americanus*). We found that fawns radio-collared with a higher body mass index were more likely to survive. We examined other relationships that could have an effect on fawn survival. Lagomorphs were examined to see if there population numbers had an effect on pronghorn fawn survival. We found a relationship between lagomorph density and fawn survival, as rabbit density increased pronghorn fawn survival increased. Ground squirrel density was found to have no effect. Coyote density was studied to see if coyote density effected pronghorn survival. No relationship was found between coyote density and pronghorn fawn survival. We examined habitat variables that could affect pronghorn fawn survival. NDVI was examined and we found no correlation in this study. Pronghorn fecal samples were collected and analyzed at a laboratory to look for diet quality correlation to pronghorn survival. We found a correlation between diet quality (DAPA) and pronghorn fawn survival. Diet quality can be linked to habitat quality, as habitat quality increases so does pronghorn fawn survival. Habitat quality, rabbits, and a fawn's BMI all were linked to increased fawn survival.

MOSBY, CORY. Idaho Department of Fish and Game, Boise, Idaho 83707. **THE BEAVER RESTORATION ASSESSMENT TOOL (BRAT), A GUIDE FOR BEAVER-MEDIATED HABITAT RESTORATION IN IDAHO.**

The ecosystem services provided by beaver and their dam building activities are an important component in shaping instream and riparian habitat for a diverse array of flora and fauna. In the US, historical beaver populations existed at an order of magnitude greater than present day, and their influence on aquatic and riparian ecosystems was extensive. Today, beaver and their dam building activities have an important role to play in conservation, but where to focus these efforts requires serious consideration due to landuse change, human infrastructure, and existing habitat. The Beaver Restoration Assessment Tool (BRAT), is a GIS based product being developed for Idaho by the Ecogeomorphology and Topographic Analysis Lab at Utah State University. Using a combination of ecologic, geomorphic, hydrologic, and anthroprogenic spatial layers, the BRAT predicts where dam building beavers can persist, where they may be useful as a restoration tool, and where potential for human conflict exists. While not a definitive guide, this tool provides an empirically driven first cut on where and how to guide habitat restoration and management using beavers. This presentation serves as an introduction to the Idaho BRAT, describes how it is being developed, some limitations and considerations for its use, and sets the stage for how this tool can inform beaver-mediated restoration activities across the state.

OLSOY, PETER J.*, J.S. Forbey, L.A. Shipley, J.L. Rachlow, N.F. Glenn, and D.H. Thornton. School of the Environment, Washington State University, Pullman, WA 99164 (PJO, LAS, DHT); Department of Fish and Wildlife Sciences, University of Idaho, Moscow, ID 83844 (JLR); Department of Biological Sciences, Boise State University, Boise, ID 83725 (JSF); Department of Geosciences, Boise State University, Boise, ID 83725 (NFG). **MAPPING DIET QUALITY FOR PYGMY RABBITS WITH UNMANNED AERIAL SYSTEMS.**

Assessing habitat quality is a primary goal of ecologists, yet evaluating habitat features that relate strongly to habitat quality at a fine-scale resolution across broad-scale extents is challenging. Unmanned aerial systems (UAS) provide an avenue for bridging the gap between field-based habitat measurements and satellite-based remote sensing. Our goal in this study was to evaluate the potential for UAS technology to estimate several dimensions of dietary quality that provide forage for pygmy rabbits (*Brachylagus idahoensis*) in a sagebrush-steppe environment. We mapped diet quality across two sagebrush landscapes in Idaho, USA. First, we classified the vegetation at both study sites with object-based image analysis (OBIA) and machine learning that resulted in overall classification accuracy of 81-87%. Next, we used Fragstats to compare landscape patterns between sites. Finally, we performed regression kriging to interpolate point measurements of crude protein and several plant secondary metabolites (PSMs) present in sagebrush across the landscape. This work illustrates an approach for garnering fine-resolution habitat data across broad landscapes for use in studies of animal ecology, conservation, and land management.

PARKER, KRISTINA J.* and Jay Carlisle. Boise State University, Boise, Idaho 83725.David S. Pilliod. U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Boise, ID 83706. John O. Cossel Jr. Department of Biological Sciences, Northwest Nazarene University, Nampa, Idaho 83686. Charles Baun. Idaho Army National Guard, Environmental Management Office, Boise, Idaho 83705. **EFFECTS OF HABITAT DISTURBANCES ON REPTILE SPECIES RICHNESS AT THE MORLEY NELSON SNAKE RIVER BIRDS OF PREY NATIONAL CONSERVATION AREA, IDAHO**

The Morley Nelson Snake River Birds of Prey National Conservation Area (NCA) in southwest Idaho has experienced increasing disturbances to wildlife habitats, especially from wildfires and invasive plant species. Published studies have shown that these disturbances can alter the quality of local habitat as well as have landscape level effects such as habitat fragmentation. Although the NCA was established because of the nesting habitats for eagles, hawks, and falcons, the importance of healthy prey populations has long been recognized. Snakes and lizards are important prey for raptors and the NCA supports the highest diversity of these species in the state. The objective of our study was to assess how local habitat conditions affect the richness and density of reptiles in the context of landscape-level wildfire disturbances. In 2018, we surveyed for reptile species in seven different habitat types throughout the NCA. Habitats were assessed on the basis of shrub and grass density, and bare ground. Preliminary results suggest that these habitat types have been strongly influenced by wildfires. Invasive annual grasses and time since last fire were important predictors of habitat condition. In 2018, we captured or observed seven snake species and seven lizard species. Reptile diversity and abundance varied among habitat types, suggesting that there may be winners and losers associated with fire regime changes in southwest Idaho.

RABON, JORDAN C.* and T. N. Johnson, University of Idaho, Moscow, ID 83844, M. Ricca, and P. Coates, United States Geological Survey, Dixon, CA 95620. **INFLUENCE OF REPRODUCTIVE STATUS OF GREATER SAGE-GROUSE ON HABITAT SELECTION IN A JUNIPER DOMINATED LANDSCAPE.**

Habitat partitioning, a process that facilitates coexistence among potential competitors through differential resource use, occurs among age classes and between sexes within a species. Habitat partitioning is known to occur among greater sage-grouse (*Centrocercus urophasianus*, hereafter, sage-grouse) males and females, but the extent to which reproductive status could affect partitioning between hens with and without broods has received less attention. Furthermore, the extent to which partitioning is affected by conifer expansion into sagebrush steppe has not been considered. Conifer expansion reduces shrub and herbaceous cover, fragments sagebrush habitat, and potentially reduces resource availability for sage-grouse. Altered landscape heterogeneity and composition could influence partitioning between hens with and without broods. We investigated whether reproductive status influences habitat characteristics selected by hens in a landscape that has undergone significant western juniper (*Juniperus occidentalis,* hereafter, juniper) expansion into sagebrush steppe. Our study area is in the Owyhee Mountains of southwestern Idaho and encompasses a gradient of juniper cover. We collected habitat data at known-use locations for hens with broods (n = 11) and without (n = 16) during spring and summer of 2017-18. Forb cover (± *SE*, 9.03% ± 0.37%) and shrub cover (20.26% ± 0.47%) were similar between habitats selected by

hens with broods (n = 43) and without (n = 53). Resource selection functions will be applied to additional habitat variables, including juniper cover at multiple spatial scales, to further evaluate whether habitat selection differed between hens based on reproductive status. Evaluating habitat partitioning among female sage-grouse will aid management efforts in a conifer-dominated landscape. Findings are preliminary and provided for timely best science.

TEMPE REGAN (tempe.regan@gmail.com), Idaho Department of Fish and Game, Boise, Idaho, U.S.A. Colleen Moulton, Idaho Department of Fish and Game, Boise, Idaho, U.S.A.
Jay Carlisle, Department of Biological Sciences and Raptor Research Center, Boise State University, Boise, Idaho, U.S.A. **AN UPDATE ON YELLOW-BILLED CUCKOOS IN IDAHO: MONITORING EFFORTS, RESULTS, AND FUTURE ACTIONS**

The Intermountain Bird Observatory conducted breeding season surveys for Yellow-billed Cuckoos in riparian areas with moderately to highly suitable habitat across the Idaho Department of Fish and Game Regions 4, 5, and 6 in Idaho from June 15 – August 8, 2018. Our objective was to survey the best potential cuckoo habitat within each region. Our efforts in Region 4 were augmented with surveys funded by the Bureau of Land Management within the Shoshone Field Office. We surveyed sites with a mix of historic cuckoo survey efforts and detections as well as new areas along the Big and Little Wood Rivers, the main stem of the Snake River, the Henry's Fork, and the South Fork of the Snake River. Using a standardized protocol, we conducted four repeat surveys of 22, 21, and 30 distinct survey sites in Regions 4, 5, and 6, respectively. We detected Yellow-billed Cuckoos 31 different times, some of which almost certainly included repeat detections of individuals, and estimate these detections represent approximately 11 to 13 individual birds. Our survey results, combined with detections from historic surveys, suggest that the Yellow-billed Cuckoo occurs regularly but sporadically across a broad spatial scale in Idaho and some areas of habitat likely support breeding cuckoos. Continuing standardized surveys for cuckoos throughout Idaho, to establish consistent, baseline data for cuckoo occurrence across multiple years will provide data that can be used to develop models of cuckoo habitat at a statewide level. To aid conservation and management efforts, we suggest future research on Yellow-billed Cuckoos in Idaho include the study of insect populations and how these may drive cuckoo occurrence, examining loss of large cottonwood galleries across the breadth of cuckoo habitat in Idaho, and targeting key areas for cuckoo habitat restoration.

RILEY, IAN*[1] , C. Conway[2], D. Musil[3], and S. Roberts[3]. [1]Department of Fish & 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; [3]Idaho Department of Fish and Game, Boise, Idaho 83712. **ESTIMATING DETECTION AND SURVIVAL PROBABILITIES OF SAGE-GROUSE BROODS: A COMPARISON OF FIELD METHODS**

We used greater sage-grouse hens with broods that were radio-marked in southern Idaho in 2016-2017 to compare the effectiveness of three brood survey methods: daytime flush-count surveys, nighttime spotlight surveys, and brood fecal surveys. We used 2 approaches to compare these 3 survey methods: 1) Cormack-Jolly-Seber (CJS) models to estimate brood detection and survival probabilities from 49 radio-marked hens with broods from 7 to 42 days after hatch (DAH) and 2) a double-observer method to compare detection probabilities at 42 DAH. Brood detection probability for daytime flush-count surveys increased with brood age from 57.2% just after hatch to 87.4% at 42 DAH. In contrast, brood detection probability for brood fecal surveys did not vary with brood age and was 75.0% (95% CI = 65.1 - 82.9) throughout the brood-rearing stage. Daily brood survival from brood fecal surveys increased with age and differed between years (96.8 - 99.9% in 2016 and 99.8 - 99.9% in 2017), whereas brood survival estimates from daytime flush surveys did not vary with brood age (99.1% ± 95% CI = 97.9 - 99.6). At 42 days after hatch, brood detection probabilities were relatively high (>85%) but none of the 3 methods had perfect detection. Explicitly accounting for imperfect detection during brood surveys can improve inferences regarding brood survival in sage-grouse. Furthermore, brood fecal surveys are a novel, effective method for measuring brood survival that doesn't require field personnel to flush hens and their broods during daytime hours, which may be detrimental to survival.

ROBATCEK, SIERRA[1],* C. White[2], E.K. Strand[1] and R.A. Long[1]. University of Idaho[1], Moscow, Idaho 83844, Idaho Department of Fish and Game[2], Jerome, Idaho 83338. **USING NUTRITIONAL -LANDSCAPE MODELS TO PREDICT PREGNANCY RATES OF ELK AT BROAD SPATIAL SCALES.**

Over the last two decades, some elk populations in Idaho have begun to display uncharacteristic variability in population performance. One hypothesis for explaining this variability is that inadequate quality and abundance of forage resources on summer-autumn ranges is negatively affecting the nutritional condition of female elk, leading to cascading effects on population vital rates and performance. We intensively sampled forage quality and biomass for elk in three different populations in Idaho that spanned a wide range of habitat types and pregnancy rates. We then used those data in combination with remotely sensed data on vegetation greenness, forest structure, precipitation patterns, and other variables to: 1) develop spatiotemporally dynamic models for predicting variation in the nutritional landscape available to elk in each study population; and 2) model variation in pregnancy rates of elk as a function of variation in the nutritional landscape. Both the maximum and the coefficient of variation of usable forage biomass (a measure of the amount of available forage that is of sufficiently high quality to support reproduction) in summer and fall were positively related to pregnancy rates of elk (adjusted R^2 of the best model = 0.64). In contrast, mean usable biomass in either season was unrelated to pregnancy rates. This suggests that

landscapes that are both heterogeneous and contain at least some patches of high-quality forage are important for maximizing reproductive performance of elk populations. Our results can be used to predict pregnancy rates of elk across much of Idaho as a function of remotely sensed data, and provide insight into why some elk populations have been experiencing depressed pregnancy rates and overall performance.

SANCHEZ, DANA, L. Ellsworth, and B. Dugger. Oregon State University, Corvallis, OR 97331.
LEAPING INTO LEADERSHIP ON DIVERSITY, EQUITY, AND INCLUSION...DON'T FORGET THE MAP!

Achieving equitable representation, retention, promotion, and success among individuals from traditionally underrepresented identity groups has been a persistent challenge in natural resource disciplines and institutions. OSU's Department of Fisheries and Wildlife recognized the need to get intentional about addressing these deficits and developed its first Diversity Plan in 2008. New policies and practices in the intervening years nudged progress toward aspirational goals at scales from university-wide to our own department, but our 2016 department-scale climate survey highlighted the need to accelerate progress. We engaged in an intensive rebuild process to produce our current (2018) plan, which looks beyond recruitment to how we can transform our daily culture and climate to enable persistence and success of those who are within our unit, across ranks and roles. Our actions range from quarterly lunch-and-learn events to a paid research technician program designed to build both technical skill and wildlife-insider social capital among undergraduates approaching graduate school. We will share key elements of our process, 2018 plan, and practices that we are pursuing as well as how we are holding ourselves accountable to these commitments. We have enjoyed some successes and some disappointments, but are hopeful that sparking these conversations can help us all succeed in this important yet challenging work.

SERVHEEN, GREGG and R. SEIDLER. Idaho Department of Fish and Game, Boise, ID 83712
MANAGEMENT OF WILDLIFE MIGRATION AND MOVEMENT IN IDAHO: KEEPING THE PATH CLEAR.

Wildlife migration and movement is an increasingly important management issue. Science and technology is continuing to provide the specifics on the importance of migration and movement to sustaining species and their ecosystems. But the very rapid pace of human population growth and land use changes in nearly every western state; the cross-cutting nature of the topic to land, population, and habitat managers; and the relatively high cost of any migration management actions all call for new solutions, partnerships, funding, and collaboration and the time needed to grow positive conservation outcomes. The Department of Interior's SO 3362 has helped bring attention and capacity to this issue in the 11 western states, including Idaho. We discuss the five

identified priority areas in Idaho's SO 3362 state plan and actions being taken across the state to address wildlife migration and movement in the context of the existing science and the management challenges outlined here. In particular, we discuss efforts to develop a more comprehensive road kill database to inform Department of Transportation projects and the different management and communication strategies we are taking to effect positive outcomes for wildlife migration and movement.

Ian T. Smith*, Janet L. Rachlow, Leona K. Svancara, Sonya J. Knetter, Jason W. Karl, and Tim R. Johnson. Department of Fish and Wildlife Science, University of Idaho, Moscow, ID 83843 USA (ITS, JLR, JWK); Idaho Department of Fish & Game, Moscow ID 83843 USA (LKS); Idaho Department of Fish & Game, Boise, ID 83707 USA (SJK); Department of Statistical Science, University of Idaho, Moscow, ID 83843 USA (TRJ) **HABITAT OVERLAP IN SAGEBRUSH DOMINATED BASIN AND RANGE: AN ASSESSMENT OF UMBRELLA SPECIES EFFICACY**

Loss and degradation of sagebrush landscapes across the Western US has prompted large-scale land management aimed at conserving and restoring habitat for Greater Sage-grouse (*Centrocercus urophasianus*). However, the degree to which such actions also conserve habitat for other sagebrush-dependent species has not been quantified in many cases. The pygmy rabbit (*Brachylagus idahoensis*) is a species of conservation concern due to its obligate relationship with sagebrush, and our goal was to evaluate the degree to which these two species share habitat both spatially and temporally. We focused efforts on east-central Idaho where spatial ecologists have developed seasonal species distribution models (SDM) for Sage-grouse based on extensive data sets. We hypothesized that overlap between Sage-grouse and pygmy rabbits would be extensive and greatest during the winter season. We used confirmed records of pygmy rabbit occurrence in this region and the program Maxent to build distribution models incorporating a diversity of environmental factors representing topographic, vegetation, fire, climate, and soil characteristics. We compared a single SDM representing year-round distribution of pygmy rabbits to four models for Sage-grouse; a spring season model, a summer model, a winter model, and a general, all-seasons model. We also conducted field surveys to determine pygmy rabbit occupancy and measure habitat characteristics, and we used those data to model habitat selection in a regression framework and check accuracy of remotely sensed data. Year-round distribution models exhibited relatively high overlap between species during all seasons, driven primarily by distribution of sagebrush cover. We discuss individual environmental predictors and seasonal trends in patterns of overlap. The model of predicted habitat for pygmy rabbits can be used to prioritize locations for pygmy rabbit surveys, and regions of high overlap between grouse and rabbits can help identify areas for land management, conservation, or restoration efforts.

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. **MAPPING MARSH BIRD BREEDING HABITAT: RANGEWIDE MODELS TO GUIDE STRATEGIC CONSERVATION**.

Spatial models are commonly used to predict distributions and differentiate optimal habitat from sub-optimal habitat for wildlife, and thus play a pivotal role in conservation planning and management for many species. Secretive marsh birds are a widely distributed group of birds that include multiple threatened and endangered species, and many marsh birds have experienced range contractions or population declines over broad spatial and temporal scales. Identification of remaining optimal breeding habitat is thus imperative for effective conservation of marsh bird populations. Our objective was to develop spatial models to predict the distribution of optimal breeding habitat for 14 species of marsh birds across their ranges within the continental United States (U.S.). We used recently developed multi-scale, hierarchical Bayesian occupancy models to build species-specific spatial habitat models for each of 14 marsh bird species across their entire U.S. breeding ranges. We modeled marsh-bird habitat as a function of wetland, land cover, and human disturbance attributes measured over multiple spatial scales, where top covariates included in each species' model were scale optimized and selected for optimal prediction. We used raster regression analyses to translate occupancy models into maps of predicted habitat suitability for each species, using covariate data measured at a 30-m resolution over the breeding range for each species. Our models enable identification of optimal breeding habitat for each individual species, as well as areas that provide optimal habitat for multiple marsh birds that could serve as hotspots for strategic conservation efforts. This work thus provides a vital step towards conserving the most valuable remaining habitat for marsh birds across the continental U.S., and provides a baseline set of predictions that can be updated over time and adapted locally as additional field data are collected.

LEONA K. SVANCARA, John T. Abatzoglou, Beth Waterbury. Idaho Department of Fish and Game, Moscow, Idaho 83843, University of Idaho, Moscow, Idaho 83843. **MODELING CURRENT AND FUTURE POTENTIAL DISTRIBUTIONS OF MILKWEEDS AND THE MONARCH BUTTERFLY IN IDAHO**

Monarch butterflies (*Danaus plexippus*) are widespread in North America, but appear to be experiencing large rangewide declines. Causes of recent declines are increasingly understood and likely involve multiple biotic and abiotic stressors including climate change and loss and degradation of native milkweed (*Asclepias* spp.), monarchs' obligate larval host plant. Recent broad-scale modeling efforts suggest milkweed and monarch distributions in the eastern United States will expand northward during summer months while fine-scale modeling of western population overwintering sites in California indicate shifts inland and upward in elevation. However, species' response to climate often varies across its range and the scale of the climate data used can have effects on model results and potential adaptation measures, particularly in areas of complex topography. We developed fine-scale models of monarch breeding habitat and milkweed distributions in Idaho, an area of importance to recruitment in the western monarch overwintering population. Our models accurately predict current distributions for showy

milkweed, swamp milkweed, and monarch with AUC = 0.899, 0.981, and 0.929, respectively. Our results suggest that at a more local/state scale, non-climatic factors such as soil depth, distance to water, and elevation contribute significantly, often overriding climate variables. We further assess changes in potential habitat under mid-21st century climate change scenarios and potential management implications of these changing distributions. Models project that potential suitable habitat for showy milkweed decreases slightly statewide while habitat for swamp milkweed increases by a factor of 2-3. Projected amounts of suitable habitat for monarch are likely to remain roughly stable with expansion nearly equal to contraction under a moderate scenario and slightly greater when under the more severe scenario. Our study shows that even with changing climates, suitable habitat for monarchs and/or milkweeds will likely continue to be found in managed areas traditionally seen as priority habitats in Idaho through mid-century.

TIM C. SWEARINGEN, Idaho Department of Fish & Game St Anthony, ID 83445; Edward D. Davis, Western Illinois University; Robert W. Klaver, U. S. Geological Survey, Iowa Cooperative Fish and Wildlife Research Unit, Iowa State University; Charles R. Anderson, Colorado Parks and Wildlife; Christopher S. DePerno, North Carolina State University; Jonathan A. Jenks, South Dakota State University; Christopher N. Jacques, Western Illinois University

INFLUENCE OF SPATIAL ALIGNMENT AND DENSITY ON THE EFFECTIVENESS OF REMOTE CAMERA STATIONS

Remote (trail) cameras provide a cost-effective, non-invasive approach for investigating a variety of natural history and conservation concerns for species that are solitary, mobile, and occur at low population densities. Researchers often use paired cameras to increase detection and increase the likelihood of detecting bilateral images. Bilateral images improve the ability to uniquely identifying individuals which is imperative for capture-recapture methods to estimate abundance/ density. No studies have rigorously evaluated the potential effects of camera type and alignment on performance of paired camera stations. We quantified potential effects of camera type and camera alignment on total images, animal images, and exposure events recorded at paired camera stations. The number of exposure events differed ($F_{1,72} = 59.10$, $P \leq 0.001$) between stations with aligned ($\bar{x} = 3.97$, 95% CI = 2.00–5.95) and staggered cameras (0 exposure events). On average, about 4% (range = 0-19%) of images from aligned cameras were over/underexposed. We documented no differences in the number of exposure events among camera types ($F_{2,71} = 0.17$, $P = 0.84$). We also evaluated the effect of low (1–2/9 km^2), moderate (4–6/9 km^2), and high (8–10 /9 km^2) camera station densities on bobcat detections for capture-recapture (CR) methods. We failed to detect differences ($P \geq 0.93$) in moderate and high camera densities across probability of capture and recapture parameters we tested (number of bobcat photos, number of individual bobcats, number of stations, and recaptures). Our detection results suggested an optimal camera station density was a moderate density of 4–6 camera stations /9 km^2. We suggest that future surveys using paired camera stations for research, inventory, or monitoring implement a staggered camera alignment to eliminate exposure events and use a moderate density to increase captures of target species.

TINKLE, ZOE[1], MICAH LAUER[2], and Jennifer S. Forbey[3]. [1]Idaho Army National Guard, Boise, Idaho 83705. [2]Heritage Middle School, Meridian, Idaho 83646. [3]Boise State University, Boise, Idaho 83725. **IDAHO ADOPT A SCIENTIST PROGRAM (IASP): ENVIRONMENTAL EDUCATION/OUTREACH FROM THE PERSPECTIVES OF THE RESEARCHER AND THE EDUCATOR**.

There is need to inspire and train the next generation of scientists who will conserve and manage local wildlife, plants and entire ecosystems in Idaho and beyond. In addition, it is equally imperative to foster the development of a conservation ethic in students that will pursue careers outside the conservation field. The Idaho Adopt a Scientist Program (IASP) was created to (1) educate teachers and their students about local research and conservation, (2) provide an opportunity for students to experience how the scientific method is used to solve real-world conservations problems in a local and familiar ecosystem, and (3) promote effective communication of science to the public of all ages. Initially funded by the 2015 Idaho Chapter of the Wildlife Society's Management Conservation, and Education Grant Program, the IASP is in its fifth year of providing local students and educators opportunities to connect with researchers and ecosystems in the classroom and the field. We will provide an overview of the IASP experience from the viewpoint of the researcher and of the educator. In addition, we will discuss the valuable impact education and outreach has for both the science and education communities.

TURNER, HILARY and R. Seidler. Idaho Department of Fish and Game, 4279 Commerce Circle, Idaho Falls, ID 83401. **CITIZEN SCIENCE AND ROAD ECOLOGY INTERSECT: INSPIRING LOCAL PASSION FOR ROADKILL DATA COLLECTION.**

Road ecology is an emerging frontier that reveals multi-fold detrimental impacts to wildlife populations. In this discipline and beyond, science relies increasingly on citizen data collection to inform conservation decisions. In 2012, Idaho enacted the wildlife collision salvage rule, which enables citizens to salvage roadkill. The salvage rule requires citizens to report salvaged animals to Idaho Department of Fish and Game (IDFG). Since 2012, Idahoans have salvaged almost 9,500 road killed animals. Despite the success of the salvage rule, wildlife-vehicle collisions (WVCs) are still grossly underreported. To better understand the impacts of a 60-mile stretch of US-20 on wildlife in Island Park, ID, IDFG is conducting roadside carcass surveys over a two-year period. Using both staff and a team of citizen scientist volunteers, IDFG collects WVC data in addition to salvage reports. In the first year, we have documented 732 carcasses of 105 species in the project area. Of these, 401 were mammals, 138 were ungulates, 321 were birds, and 33 were herptiles. In addition to increasing local awareness of road ecology issues, the data collected in this survey supplement the existing roadkill database, identify data deficits and roadway mortality hotspots, inform state agencies in their efforts to mitigate WVCs, and help IDFG to streamline similar efforts statewide. While continuing efforts in Island Park, IDFG is developing a statewide outreach program to expand the success of these efforts.

WISHNEK, BEN[1] and Jenny Barnett[2]. [1]Bear Lake National Wildlife Refuge, Montpelier, Idaho 83254 [2]U.S. Fish and Wildlife Service Region 1 Inventory and Monitoring Branch, Burbank, WA 99323. **SUBMERGED AQUATIC VEGETATION ON THE MUD LAKE UNIT OF BEAR LAKE NATIONAL WILDLIFE REFUGE: HISTORICAL CONDITION, CURRENT STUATUS, FUTURE TRAJECTORIES**

Mud Lake is the largest contiguous wetland unit at Bear Lake National Wildlife Refuge, occupying 3340 ha, 1431 ha of which is open water habitat. As such, this unit has the potential to harbor the most expansive submerged aquatic vegetation community on the refuge, and provide valuable foraging and molting habitat for ducks, swans, and piscivorous waterbirds. For the last 100 years, the unit has suffered from impaired water quality, first as a sediment filter for the Bear River as it is artificially diverted into Bear Lake for storage, and subsequently as a result of common carp (*Cyprinus carpio*) invasion. As a result, the submerged aquatic habitat of the unit is degraded. An assessment of the wetlands' current status within its known historical range is the necessary first step in exploring options for restoration of this wetland unit. We summarized qualitative and quantitative vegetation data from annual refuge narratives and previous studies to get a long-term synopsis of the habitat quality of the Mud Lake unit. In summer 2018, we collected data from thirty generalized random tessellation stratified points to assess the current status of submerged aquatic vegetation and water quality. Assessment of these datasets depicts a wetland unit falling short of its Refuges' 2013 Comprehensive Conservation Plan objectives. However, healthy stands of beneficial submerged aquatic vegetation were observed in the portions of the unit less influenced by diverted Bear River water. Therefore, the potential exists for increasing the productivity of the submerged aquatic vegetation communities on the Mud Lake unit.

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 **OUTCOMES OF INDIRECT INTERACTIONS ON RESOURCE AVAILABILITY IN GREATER SAGE-GROUSE (*CENTROCERCUS UROPHASIANUS)* BROOD-REARING HABITAT**

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 persistence. In the presence of large herbivores, such as livestock, brood-rearing habitat and food resources for Greater sage-grouse may be affected through direct and indirect interactions within mesic meadow plant communities. 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.

YOUNG, AARON C* and Tracey N. Johnson. University of Idaho, Moscow, ID 83844. Todd E. Katzner and Douglas J. Shinneman. U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Boise, ID 83706 **EFFECTS OF JUNIPER WOODLAND EXPANSION ON THE FUNCTIONAL COMPOSITION AND HABITAT USE OF SAGEBRUSH SMALL MAMMAL COMMUNITIES.**

Expansion of juniper woodlands into sagebrush steppe has led to concern over effects that changes in landscape structure and composition may have on populations of sagebrush-obligate species, most notably greater sage-grouse (*Centrocercus urophasianus*). This concern has prompted management projects that would remove juniper in order to improve habitat for sage-grouse populations. However, for other groups of sagebrush-associated species, little is known about potential effects of juniper mediated changes to sagebrush habitat on aspects of fundamental management interest, such as species interactions, density, and habitat use, and how juniper removal might restore these processes. Small mammals may play a vital role in the sagebrush ecosystem. Utilizing a diverse set of functional traits, individual small mammal species regulate understory vegetation through herbivory and seed dispersal, aerate the soil, are inter-guild predators, and act as important prey for raptors and mesocarnivores. Composition of community-level functional traits (e.g., trophic guild) mediated by habitat may have implications for species interactions (e.g, predation rates) and demographic effects for species of conservation concern. We conducted small mammal trapping in 2017-18 in Owyhee County Idaho in areas where juniper will be removed as part of the Bruneau-Owyhee Sage Grouse Habitat Project. Using a spatially-explicit capture-recapture (SECR) analysis, we tested effects of habitat variables on small mammal community functional composition, density, and habitat use. To our knowledge this is the first use of a SECR analysis for small mammals. This preliminary analysis allowed us to examine the effects of individual trap-level habitat characteristics on occupancy probability, as well as to estimate site-level density for multiple species of small mammal. These data will help managers better understand potential responses of small mammals to juniper removal, and implications for effects on community-level processes such as predation rates.

CHARLES R. PETERSON and Patrick D. Giltz. Department of Biological Sciences, Idaho State University, Pocatello, Idaho 83209-8007. **LINKING CROWDSOURCED AND CITIZEN SCIENCE DATA TO STATE SPECIES DIVERSITY DATABASES.**

Current information on species occurrence and distribution is needed to identify and address conservation problems. Crowdsourced and citizen science projects are a very important source of data for biodiversity conservation, especially for nongame species. However, we need to quality control and link these data to species diversity databases such as NatureServe to maximize their use. The objective of this presentation is describe our efforts to link observations from the Idaho Amphibian and Reptile iNaturalist Project to the Idaho Department of Fish and Game's species diversity database. Our project has been successful in obtaining and confirming over 2,000 photo vouchered observations since June of 2016. We see our lab's contributions as (1) helping to obtain observations through creating the project, developing identification materials, and recruiting participants; (2) confirming and curating the observations; and (3) directly collaborating with state database managers to periodically import the quality controlled observations.

LONSO, NICOLE. Idaho Department of Fish and Game, Lewiston, Idaho 83501.
REDESIGNING ACCESS YES IN THE CLEARWATER REGION

Access Yes is a state wide program aimed to increase public access to private lands for hunting. This program either pays landowners or does restoration work in exchange for access. Landowners still control a lot of the access on their property, but historically have struggled with finding the balance between unlimited access and knowing who is on the property. In the Clearwater Region, we have a new tool that eliminates the need for landowners to be pestered by phone calls and knocks on the door, but still allows them to know exactly who is on their property. We are utilizing an online sign in system. This system has a calendar set up which allows landowners to limit the number of hunters allowed in a day. The system can collect any information the landowner desires including hunter names, email addresses, phone number, vehicle make and model, and license plate number. Landowners can even specify how many days a hunter can sign up for, which eliminates the concern of one hunter booking all of hunting season. When a hunter signs up for a day, they are sent a confirmation email which they print out and leave in their vehicle. That way the landowner can verify they have signed in. We in the Clearwater Region are striving to make the Access Yes program a better experience for both landowners and sportsmen.

KAYTE GROTH*, Jon Horne[1], Sophie Gilbert[2], and Ryan Long[2]. [1]Idaho Department of Fish and Game, Lewiston, Idaho 83501. [2]University of Idaho, Moscow, Idaho 83844. **EVALUATING 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 developed a movement classification algorithm to identify individual preferred foraging patches located within a depredated agricultural field. Using these locations we deployed a deterrent system that intended to interfere with the detection of and mimic natural predation risk. We deployed the deterrent system on 4 garbanzo bean crop fields at weekly intervals, alternating between treatment and no-treatment periods beginning in August and ending in October of 2018. The deterrent system consisted of 3 components: 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 expelled mountain lion urine at regular intervals). We analyzed the efficacy of the treatment system by quantifying changes to space use and comparing movements between pre- and post-treatments. We conducted analyses on 2 different scales, a step selection function and synoptic model, to quantify growing-season time budgets and the effectiveness in reducing the amount of time the GPS-collared deer spent foraging in a treated garbanzo bean field.

JOHN GUTHRIE*, Sophie Gilbert[1], and Shane Roberts[2]. [1]University of Idaho, Moscow, Idaho 83844. [2]Idaho Department of Fish and Game, Boise, Idaho 83712. **MODIFYING ELK BEHAVIOR TO REDUCE AGRICULTURE CROP DAMAGE**

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 are only partially and/or temporarily effective. The study's focus is to develop tools for reducing elk use of agriculture crops by determining how various deterrent treatments affect elk behavior and subsequent crop damage. In the study's first year, 39 adult elk were captured and fitted with GPS collars in areas with high levels of elk use in agriculture throughout southern Idaho. Elk were captured at or near fields that were actively being utilized and damaged. GPS collars recorded elk locations every 20 minutes. We developed and tested 4 deterrent treatments, designed to prevent elk from utilizing agriculture crops during the growing season. Deterrents tested included; 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) application of a taste-based repellant sprayed on crops. Approximately 50% of the collared elk received deterrent treatments, while the remaining 50% not deterred from fields, were used as a control. We will repeat and/or modify the testing of deterrent treatments in summer 2019. The behavioral and movement responses of collared elk and observational assessments of total elk use in treatment fields, compared with the responses of elk using untreated fields will be used to quantify the effectiveness of deterrent treatments.

McDevitt, Molly* and Paul Lukacs. University of Montana Wildlife Biology Program, Missoula, Montana 59812. Frances Cassirer. Idaho Department of Fish and Game, Wildlife Research, Lewiston, ID 83501. Mark Hurley. Idaho Department of Fish and Game, Wildlife Research, Boise ID 83712. Shane Roberts. Idaho Department of Fish and Game, Wildlife Research, Boise ID 83712. **DISPARATE SAMPLING METHODS FOR MONITORING MOUNTAIN GOAT POPULATIONS**

Estimating the distribution and abundance of wildlife populations is a critical component to the conservation of wild species. Precise estimates of these parameters enables biologists to productively manage and preserve the animal populations they oversee. Methods for monitoring high density species populations are frequently and continuously being improved upon. However, identifying effective methods for monitoring low density species populations (e.g. mountain lions, wolves, mountain goats, and wolverine) has proved challenging due to small population sizes and difficulty of access to low density species habitat. Current approaches for surveying low density species (e.g. aerial surveys, baited camera traps, DNA sampling) often provide insufficient information and application of statistical models to these data can be complex. In this study, and in partnership with Idaho Department of Fish and Game, I will test disparate non-invasive, ground-based methods for monitoring mountain goat (*Oreamnos americanus*) populations in Idaho, USA. This project will compare and contrast findings from

field and analytical methods: camera trapping techniques, single-observer ground surveys, and double-observer ground surveys. Here, I describe the field methods and statistical models being tested and developed in research project. Additionally, I will present findings from the first field season (June – August 2018) of testing these three methods. By improving occupancy and abundance estimates for mountain goat populations, biologists can begin to make smarter conservation decisions around mountain goat management.

MILLER, ROBERT A.[1], Jay D. Carlisle[1], and Rema Sadak[2]. [1]Intermountain Bird Observatory, Boise, Idaho 83725 and [2]USDA Forest Service Region 4, Ogden, UT 84401. **ANNUAL VARIATION OF NORTHERN GOSHAWK BREEDING AND PRODUCTIVITY IN AND AROUND THE NORTHERN GREAT BASIN.**

The Northern Goshawk is a generalist predator occupying boreal and temperate forests of the Holarctic. The species is monitored by many forest management agencies as an indicator or surrogate species for forest health. However, large scale fluctuations in prey cycles, weather, and climactic conditions may have large influence on annual breeding behavior and success. Understanding these broad patterns will help place local results into context. We collected Northern Goshawk monitoring data from most forests in and around the northern Great Basin and analyzed these data for geographic-scale patterns in breeding and productivity. Here we present the preliminary findings of this analysis.

MILLER, ROBERT A.[1], Heather M. Hayes[1], Jay D. Carlisle[1], and C. E. Moulton[2]. [1]Intermountain Bird Observatory, Boise, Idaho 83725, and [2]Idaho Department of Fish and Game, Boise Idaho, 83712. **THE DANGEROUS LIFE OF A SHORT-EARED OWL**

The Short-eared Owl is an open-country species that breeds in the northern United States and Canada, and has likely experienced a long-term, range-wide population decline. However, the cause and magnitude of the decline are not well understood. Project WAfLS (Western Asio flammeus Landscape Study) participants spend considerable time out in Short-eared Owl habitat surveying for the species and have noted a number of direct causes of mortality. We will summarize the non-habitat related threats that this species face on our open-country landscapes.

JOSH RYDALCH. Idaho Dept. of Fish and Game Idaho Falls, ID 83401. **MOOSE!! A PROJECT UPDATE ON TRANSLOCATION OF MOOSE IN EASTERN IDAHO**

Shiras moose (*Alces alces*) are a common sight in Eastern Idaho. They are found in mountain shrub habitats as well as riparian strips which can lead them into human occupied areas. Social tolerance to most wildlife in Idaho is normally quite high yet the pinned back ears of an angry cow moose as you approach her shrubs in your yard makes it less so. The Idaho Department of Fish and Game (IDFG) has been dealing with these types of scenarios for decades and have moved up to 120 moose out of less tolerable areas in 1 year. Most of these animals are marked yet IDFG wasn't seeing a return to bag by hunters in proportion to what was thought to be on the landscape. Beginning in 2017, a project started with these translocated moose by fitting GPS radio collars on those being moved out of residential areas. The study area is Southeast and Upper Snake Region of IDFG. The idea was to see how these moose behave after a long ride in a moose trailer (horse trailer adaptation) to a new home. IDFG wanted to know are they surviving? Are they staying put or moving long distances? Does distance being moved make a difference? Are they returning to hunters bag? Is poaching an issue? And of course more questions would come about as we went forward. To date we have collared 15 moose in both Regions. Moose have ranged from 7 month old calves to adults (both antlered and antlerless). Movements have been variable roaming as far as 40 air miles one way or staying within a 5 mile radius. A few (N= 3) have died but most of these were in poor body condition when translocated. So far nothing has been consistent but with a small sample size and many many variables the expectations are not pronounced and this is more of a 'lets wait and see what happens' type of project. Stay tuned for more to come.

PALAZZOLO, SAL. IDFG, State Office, Boise, ID 83707; PRIVATE LAND PRESENTER
SHALLOW, JESSIE. IDFG, Salmon Region, Salmon, ID 83467; PUBLIC LAND PRESENTER
IDAHO'S BACKYARD: HOLDING THE DOOR OPEN TO HUNTING AND FISHING ACCESS TO PRIVATE AND PUBLIC LANDS

The lack of public access to private and public land has been identified as a direct threat to hunting and the shooting-sports, *Council to Advance Hunting and the Shooting Sports 2015*. Providing access to hunters is a priority for IDFG, as access to public and private lands is an important consideration for Idaho hunters when making decisions about where to hunt, *Idaho Mule Deer Survey 2017, unpublished data*. Loss of access to public lands is a growing threat, due to limited funding, management restrictions, development, and hazardous conditions following wildfires. These threats have compromised trail and road infrastructure that historically supported access to public lands. The department recognizes the importance of continued efforts to maintain and enhance access. To address these important issues the department has: 1) created and maintained the Access Yes! Program to enhance public hunting and fishing on private lands; 2) secured a 2018 public access agreement between the Idaho Department of Lands (IDL) and IDFG that continues public access to IDL properties; 3) helped develop and maintain the IDFG Large Tracts Program and; 4) created a backcountry working group to assess and pursue public access opportunities in central Idaho's backcountry.

AZIZEH, TAYLOR*, Cisneros, R, Castillo, E, Avila, C, Waits, L, Roon, D, Bailon, N, Dalgo, P. University of Idaho, Moscow, Idaho. La Universidad Técnica Particular de Loja, Loja, Ecuador.
ECOTOXICOLOGY OF BATS IN URBAN, PASTURE, AND FORESTED SITES OF THE SOUTHERN ECUADORIAN ANDES.

Urbanization and agricultural conversion are the leading global causes of deforestation and biodiversity loss. Latin America is the second most urbanized region in the world with 80% of people living in cities. Agricultural conversion is the main driver of the deforestation in tropical and subtropical countries accounting for 80% of deforestation from 2000-2010. This habitat alteration can lead to bioaccumulation of pollutants and other toxins that are harmful to humans and other species. For example, toxins leeched into the ecosystem from agriculture and urbanization that have been shown to degrade red and white blood cells and create primary physiological responses such as DNA damage. Insectivorous bats can be valuable bioindicators of human health risks because these species are at the same trophic level in the food chains as humans. The goal of this research was to evaluate whether urbanization and conversion of land to pasture was negatively affecting the physiology of bats within the Southern Ecuadorian Andes. Our study area was in the Zamora watershed near the city of Loja, and bats were captured by mist netting at 12 stream-catchments: three forest sites, three forest-pasture sites, three pasture sites, and three urban sites. Blood samples were collected from 20 bats for genotoxicology analysis. Genotoxic effects were measured using a micronuclei assay. We found high levels of DNA damage in bats captured in urban, forest-pasture, and pasture sites compared to bats captured in forested areas. We also found the highest levels of DNA damage in insectivorous bats because of the bioaccumulation of pollutants in the insects. This research provides valuable baseline data on the toxicological effects of land conversion on the overall health of bat populations, as well as identify regions with high levels of bioaccumulation that may also pose a risk to human health.

BILODEAU, NICOLE*. University of Idaho, Moscow, Idaho 83844. **EFFECTS OF DAM BODY CONDITION ON LAMB SURVIVAL OF BIGHORN SHEEP IN IDAHO.**

Nutritional condition has profound effects on the physiology and productivity of ungulates. However, little is understood about the extent to which nutritional condition limits the success of bighorn sheep (*Ovis canadensis*). We tested the hypothesis that dam body condition can be used to predict lamb survival by studying free ranging bighorn sheep in 3 study sites in Idaho: Owyhee River, East Fork of the Salmon River, and Lost River Range. During the springs of 2016-2018, we captured and collared adult ewes in each region, collected biological samples (e.g., blood, fecal, nasal and oral pharyngeal swabs) and quantified body condition and reproductive status using ultrasonography and manual palpation. We monitored a total of 144 ewes to determine individual lamb survival. Using a binomial generalized linear model, we predicted lamb survival with 5 variables—body condition score (BCS), mass, infection status, year, and site—and selected the best model fit using the lowest AIC score. The best model estimated a positive relationship between the probability of lamb survival and BCS. BCS was determined to be the most significant ($p=0.0108$) predictor of lamb survival. Our research is in accordance with past research on the influence of nutritional body condition on offspring survival in other ungulate species. Understanding the

relationships between the nutritional landscape, sheep behavior, and demography can provide valuable insights for management by identifying driving mechanisms for individual survivorship in realistically dynamic systems. Our study highlights the importance of habitat nutrition for bighorn sheep population growth in Idaho.

BRAUN, JOSIE*, and R. Miller. Intermountain Bird Observatory, Boise State University, 83725.
Short-Eared Owl (Asio flammeus) **ROADWAY MORTAILTY IN NORTHERN UTAH AND EASTERN IDAHO: INCIDENTAL DATA AND FUTURE RESEARCH DIRECTIONS.**

The Short-Eared Owl (*Asio flammeus*) is a widely-distributed, open country species. Although they are distributed globally, Short-Eared Owls have not been widely studied. The Western *Asio flammeus* Landscape Study (Project WAfLS), an eight-state cooperative effort lead by Intermountain Bird Observatory targeted at monitoring Short-Eared Owl populations and assessing landscape occupancy, collected data which seeks to identify current fluctuations in population numbers, breeding density and habitat use. Over three years of surveys (2015-2018), volunteers collected 120 GPS points where they had found and identified Short-Eared Owls which had been fatally hit by cars in Idaho, Utah and Wyoming. These mortalities were concentrated in three areas: Mud Lake, Idaho, Howell, Utah and the National Elk Refuge in Wyoming, and many of these mortalities were adjacent to or surrounded by agricultural areas. The relationship between the Short-Eared Owl and roadway mortality is not currently known, and the variables which contribute to this phenomenon have not been explored. This species is currently listed as a "Species of Greatest Concern" in Idaho and Wyoming and is listed as a "Wildlife Species of Concern" in Utah (IDFG, 2016, Utah DNR, 2017). Identifying the factors contributing to the roadway mortality of owls is crucial for their conservation and habitat management, and we are currently seeking funding for a formal survey to address the landscape characteristics which could be potential contributors to this problem. We also hope to test for the presence of second-generation rodenticides in this species, poisons which have been associated with raptor mortality.

PATRICIA KAYE T. DUMANDAN*, Boise State University, Boise, Idaho, 83725. Keith Bildstein, Pennsylvania, USA, Laurie J. Goodrich, Hawk Mountain Sanctuary, Pennsylvania, and Todd E. Katzner, U.S. Geological Survey. **ASSEMBLAGE-LEVEL TRENDS OF AUTUMN RAPTOR MIGRATION AT HAWK MOUNTAIN SANCTUARY, PENNSYLVANIA, 1934 -2018**

Long-term raptor migration count data are often used to detect population trends and identify factors associated with migratory behavior. Fluctuations in the numbers of migratory raptors recorded are used to understand the patterns and processes that underpin their response to external factors such as anthropogenic disturbances. Population-level effects of these disturbances are well -studied. However, the impact of species-level declines to the structure of migrant raptor assemblages is not clear. Using count data obtained over the period 1934 to 2018, we evaluated the trends of diversity indices of migrating raptors recorded at Hawk Mountain Sanctuary (HMS),

Pennsylvania. Preliminary results showed that index values of species richness, diversity, and evenness were declining prior to the 1980s, but has been increasing since then. On average, Broad-winged Hawk (*Buteo platypterus*), Sharp-shinned Hawk (*Accipiter striatus*), and Red-tailed Hawk (*Buteo jamaicensis*) were the most abundant species and few shifts in species rank abundances occurred across all years. Next steps are to use statistical models to evaluate the effects of historical anthropogenic factors such as direct persecution, use of contaminants (DDT), and deforestation, on assemblage structure of migrating raptors at HMS. The results will allow us to predict how large-scale human disturbances may impact diversity of migratory raptor assemblages.

KRISTOF, ANDREA and Brian Wehausen. Camas National Wildlife Refuge, Hamer, Idaho 83425. **RESTORING RESILIENCY TO HIGH DESERT WETLANDS IN THE FACE OF DECREASING WATER AVAILABILITY: MAKING THE MOST OF GROUNDWATER IN A RECHARGE SYSTEM.**

Camas National Wildlife Refuge encompasses nearly 11,000 acres of high desert in southeastern Idaho. The refuge was established in the 1930s at a time when 3,000+ acres of wetlands supported a significant amount of waterfowl production, supplied valuable stopover habitat for tens of thousands of migratory waterbirds, and provided year-round habitat for resident obligate species. However, changes in land use and climate have depleted both the surface and ground water supplies available to the refuge. Correspondingly, the habitat available to migratory waterbirds has significantly decreased and over-wintering habitat for resident obligate species has all but disappeared. The infrequent inundation of many areas challenges the integrity and persistence of these wetlands, which are critical to the executive order under which the refuge was established. Therefore, the refuge is planning to restore geological, topographical, and hydrological elements of the landscape, and to strategically reconfiguring infrastructure in order to most efficiently translate increasingly limited water resources into quality wetland habitat. In addition to a creek restoration to improve surface water supply, we also seek to more efficiently utilize groundwater by relocating wells to priority wetlands with lower seepage rates, and by filling in two ditches whose excavation may have transected the water retaining stratum that facilitated inundation of the southwestern wetlands. We anticipate that these actions will contribute to the recovery of the southwestern wetlands, allow for inundation of twice the acreage that can presently be inundated during drought years, and increase the ability of staff to manage for a more natural dynamic hydrology regime which will yield abundant and diverse resources for migratory waterbirds.

KRISTOF, ANDREA and Brian Wehausen. Camas National Wildlife Refuge, Hamer, Idaho 83425. **SHELTERBELT RESTORATION AT CAMAS NATIONAL WILDLIFE REFUGE.**

Camas National Wildlife Refuge provides cottonwood-willow shelterbelts that are of known importance to passerines as stopover habitat during migration across the Snake River Plains, and to Bald eagles as a thermal refuge during the winter. However, changes in local hydrology have produced conditions that are not conducive to the recruitment of these trees at a sustainable level. This lack of natural recruitment is now culminating in a loss of shelterbelt habitat as many of the

existing trees succumb to the end of their natural life-cycles. Given the rarity of cottonwood-willow riparian habitat on the western landscape and its importance to the regional avifauna, the shelterbelts at Camas NWR are high priorities for restoration and enhancement. In fall of 2018, the refuge initiated a twenty-year project to incrementally restore the distribution and enhance the diversity of the shelterbelt habitat. We are initially prioritizing a combination of cuttings and nursery-grown plants from the following species: Black cottonwood, Chokecherry, Golden currant, Redosier dogwood, Serviceberry, and Western snowberry. For the first three years, each out-planting receives supplemental irrigation that mimics a natural hydroperiod and, if needed, fencing to provide a barrier to herbivory. Success will be evaluated in terms of riparian acres maintained, riparian acres restored, number of individuals of each species established, and establishment rate of each species. Over the course of the project, staff seek to maintain and increase native diversity within the existing 4 miles of lotic riparian habitat, and to restore an additional 4 miles of lotic riparian habitat.

CAMERON MACIAS*, University of Idaho: College of Natural Resources, 975 W 6th St, Moscow, ID 83844; maci2896@vandals.uidaho.edu; Kim Sager-Fradkin, Lower Elwha Klallam Tribe Natural Resources, 760 Stratton Road, Port Angeles, WA 98363; kim.sager@elwha.org; Jennifer Adams, University of Idaho: College of Natural Resources, 975 W 6th St, Moscow, ID 83844; adamsj@uidaho.edu; Lisette Waits, University of Idaho: College of Natural Resources, 975 W 6th St, Moscow, ID 83844; lwaits@uidaho.edu. **COUGAR AND BOBCAT POPULATION ESTIMATION AND OCCUPANCY MODELING IN THE LOWER ELWHA KLALLAM TRIBE'S HISTORIC USE AREA.**

As a sovereign nation, the Lower Elwha Klallam Tribe sets annual harvest regulations that differ from those of Washington State. No data, however, have been collected on predator populations in the Tribe's historic use area and we lack information for setting annual tribal harvest regulations. To address this data gap, we used a combination of non-invasive genetic sampling, GPS radio collars, and a camera grid survey to estimate population size, genetic diversity, and occupancy of cougar (Puma concolor) and bobcat (Lynx rufus) populations on the north Olympic Peninsula of Washington State. First, we used specialized scat-detection dogs to locate and collect cougar and bobcat scat samples across the landscape. We divided our 606 km2 study area into 32- 4x4 km sampling cells and the scat-detection teams surveyed one cell per day. Of the 207 scat samples collected during the 2018 survey, we had an 89% success rate for genetic species identification and identified 159 bobcat and 20 cougar samples. Individual identification analyses are ongoing. Second, we equipped 3 adult (1 male and 2 female) and 2 sub-adult (1 male and 1 female) cougars with GPS radio-collars in 2018 to observe movement and dispersal. Third, we deployed a 64-camera grid survey using the same 32-cell grid system. Each grid cell contained two cameras separated by >1 km. We will continue these three surveys through 2020. This research will provide baseline data on cougar and bobcat populations in the Tribe's historic use area and help us to develop non-invasive and cost-effective methodologies for long-term monitoring and management.

MEYERPETER, MARY[1,2]*, Peter S. Coates[1], Mark A. Ricca[1], Brian G. Prochazka [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. **BROOD TRANSLOCATION AS A POPULATION RESTORATION METHOD FOR GREATER SAGE-GROUSE.**

Translocation often is used to restore populations of wildlife, including greater sage-grouse (*Centrocercus urophasianus*). However, translocated grouse typically exhibit high mortality rates, a propensity to disperse away from release sites, and low reproductive success, meaning that large numbers of individuals must be translocated to compensate for low reproduction at release sites. Minimizing the number of individuals removed from a source population while simultaneously increasing the probability of restoration at the release site is desirable. We used an Integrated Population Model (IPM) to identify the potential of brood translocation (relocating female grouse with their young chicks) as a technique to reduce impacts on the source population and increase colonization of the release site. We predicted that translocating sage-grouse with their broods would result in higher population growth per individual compared to translocating female sage-grouse pre-nesting and simultaneously reduce impacts on the source population. We are testing the effectiveness of brood translocation to restore an imperiled sub-population of sage-grouse in eastern California. We present a protocol for brood translocation, including a soft-release system to prevent brood abandonment. Preliminary observational results suggest that translocating females with broods reduces female dispersal from release site and promotes juvenile recruitment.

MEREDITH, JULIE*, Charles R. Peterson, and Patrick D. Giltz. Department of Biological Sciences, Idaho State University, Pocatello, Idaho 83209-8007. **USING CROWDSOURCED OBSERVATONS TO DOCUMENT ROAD MORTALITY IN IDAHO'S AMPHIBIANS REPTILES**

The objective of this study was to use crowdsourced observations to document taxonomic, temporal, and spatial variation in road-killed amphibians and reptiles in Idaho. We searched over 8,000 records from museum specimens, Idaho Department of Fish and Game roadkill records, and observations from the Idaho Amphibian and Reptile iNaturalist Project. Using text data (e.g., roadkill or DOR) and photographs (from iNaturalist), we identified a total of 190 records, the majority of which were crowdsourced. We are currently summarizing these records by taxonomic group (class, order, and species), time (year, month, and day), geographic location, and ecoregion to evaluate which groups and species are most affected by road mortality and when and where it has occurred. This information should be useful to attempts to reduce an important source of mortality for these animals.

MURPHY, CHRIS and Sonya Knetter, Idaho Department of Fish and Game, Boise, ID 83712.
THE PRESENT AND FUTURE DISTRIBUTION OF COTTONWOOD FLOODPLAIN FORESTS IN IDAHO: CONSERVATION AND RESTORATION IN A CHANGING CLIMATE

Idaho's distinctive cottonwood floodplain forests are now greatly diminished and their long-term viability in question. Historic and on-going impacts, including dams, diversions, and flood control have resulted in relict stands lacking seed-based tree reproduction. Climate-change induced flow alteration is likely to further impact this habitat. Despite the importance of floodplain forests to fish and wildlife (including Threatened Yellow-billed Cuckoo), and the magnitude of threats, no statewide conservation assessment exists. Project objectives were to model cottonwood forest distribution, estimate ecological condition of river valleys, and predict vulnerability of floodplains to climate-related hydrologic changes (e.g., snowpack reduction, earlier runoff timing). The distribution of cottonwoods (*Populus balsamifera* ssp. *trichocarpa*, *P. angustifolia*) was estimated using maximum entropy models. Model outputs were filtered to include only floodplains of river valleys. These floodplains were identified in GIS using Valley Confinement Algorithm layers (US Forest Service), Topographic Position Index models, and maps of riparian extent. The condition of floodplains was assessed using landscape integrity and a watershed-scale Index of Flow Modification. Modeled historic and future river flows, generated from Variable Infiltration Capacity and Precipitation Runoff Modeling System outputs integrated with downscaled global climate model results (University of Washington, Oregon State University) were used to estimate the potential effects of hydrologic change on cottonwood recruitment. Initial results indicate that most rivers in Idaho may experience earlier peak runoff and more rapid flow decline decreasing the chance of flows coinciding with late-spring cottonwood seed dispersal and seedling growth. A majority of cottonwood forests occur along highly modified rivers; this may further limit long-term cottonwood reproductive success. Cottonwoods may be most viable on minimally modified rivers flowing from high elevations where snowpack systems are likely to persist. Simulating natural flows on dam-controlled rivers will be necessary for restoring cottonwood reproduction on modified rivers.

MYERS, MEGEAN*, R. Cisneros, E. Castillo, C. Avila, T. Azizeh, D. Roon, and L. Waits. University of Idaho, Moscow, Idaho 83843. Universidad Técnica Particular de Loja, Loja, Ecuador. **DETERMINING SPECIES RICHNESS AND ABUNDANCE OF BATS IN URBAN, FORESTED, AND PASTURE-MOSAIC HABITATS IN THE SOUTHERN ECUADORIAN ANDES**.

Southern Ecuador faces ongoing degradation and loss of habitat in its main biodiversity hotspot, the Tropical Andes. Since the 1970s, annual deforestation rates have increased from 0.75% to 2.86%, and roughly 46% of southern Ecuador's original forests were converted to pasture or agricultural land by 2008. Quantifying the impacts of this land conversion on biodiversity is critical for conservation planning. Bats make excellent bioindicators because they are abundant, easy to sample, and occur in many diverse habitats. Bats are also significant ecologically- with

important roles in seed distribution, pollination, and regulation of insect populations. This research assessed the current species richness and abundance of bats in urban, pasture, and forested landscapes of the Zamora watershed near Loja, Ecuador. Data collection was initiated in summer 2017 and continued in summer 2018. Bat communities were sampled at 12 stream-catchments: three forest sites, three forest-pasture sites, three pasture sites, and three urban sites. Our main method of sampling included the use of mist-nets for 5-6 mist net hours per site each summer. We expected there to be higher species diversity and abundance in the surrounding forest and pasture habitats compared to the urban habitat. Our results showed that bat species diversity and abundance were greater in forest, forest-pasture, and pasture landscapes than in the urban landscapes. Furthermore, the greatest bat species diversity and population abundance was observed in the forest -pasture landscapes, indicating an "ecotone effect" as diversity metrics were greatest in merging landscapes (e.g., forest merging with pasture). This research provides valuable data on the current status of biodiversity and ecosystem health in this region of the southern Ecuadorian Andes. It will provide important planning information for managers in the Loja area and could be applied to other areas facing increased biodiversity loss.

BRENDA PACE, Upper Snake Master Naturalists, 6643 S Limousin Ave. Idaho Falls, ID 83404.
CONCENTRATION OF LEAD SHOT IN SURFACE SOILS AT MARKET LAKE WILDLIFE MANAGEMENT AREA.

The Idaho Department of Fish and Game (IDF&G) has an abiding interest in understanding the concentration of lead shot in surface soils at the Market Lake Wildlife Management Area (WMA). The area has supported upland game bird and waterfowl hunting for many years and toxic impacts from the ingestion of lead shot by resident and migratory birds is an important area of concern. Beginning in 2011, IDF&G sought assistance from the Upper Snake Chapter of the Idaho Master Naturalists to conduct soil sampling and analysis to help establish a baseline of lead shot concentration in areas that are open to upland game bird hunting at the Market Lake WMA. All samples were subject to a method of X-ray analysis developed in conjunction with the Idaho National Laboratory and the Idaho Accelerator Center at Idaho State University. In 2011, sampling was focused on the top two inches of soil in grassland habitat that is subject to temporary flooding where soils have not been extensively disturbed. The results showed an average concentration of 18,791 shot per acre. In 2018, sampling was conducted in an adjacent area known as the North Agricultural Fields, where soils are mechanically worked for agricultural production of small grains. In the cultivated area, lead shot concentrations were markedly lower, with an average concentration of 6,098 lead shot per acre. The results of sampling in 2011 and 2018 suggest that lead shot may persist in near surface soils in areas that have not been cultivated. In contrast, farming activities in the North Agricultural Fields may be a contributing factor in possibly moving lead shot below the two inch sample depth.

PARKER, KRISTINA J.* and Jay Carlisle. Boise State University, Boise, Idaho, 83725. David S. Pilliod. U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Boise, ID 83706. John O. Cossel Jr. Department of Biological Sciences, Northwest Nazarene University, Nampa, Idaho 83686. Charles R. Peterson. Department of Biological Science, Idaho State University, Pocatello, Idaho 83201. Charles Baun. Idaho Army National Guard, Environmental Management Office, Boise, Idaho 83705. **CHANGES IN REPTILE DIVERSITY OVER THE LAST 40 YEARS IN SOUTHWEST IDAHO**

The reptile species of Idaho have been well studied over the last 40 years in the Morley Nelson Snake River Birds of Prey National Conservation Area (NCA). Yet, little information is available on the status of these secretive animals. We compiled data from multiple studies conducted between 1977 and 2018 throughout the NCA to assess changes in richness and occupancy patterns. Trapping methods and locations were consistent through time, which provided repeat estimates of diversity and abundance of 16 species known to occur in the region. Preliminary results suggest that species richness has not changed in Southwest Idaho over the last 40 years although it appears that some species have become more common and some species less common through time. Future research will investigate factors contributing to these trends, such as changes in human use of the area, as well as changes in climate, invasive species, and wildfire.

JANET L. RACHLOW, Bastien Lecigne, and Jan U.H. Eitel. Department of Fish and Wildlife Resources, University of Idaho, Moscow, ID 83844 USA (JLR); Department of Biological Sciences, Université du Québec à Montréal, Montreal, Canada (BL); Department of Natural Resources and Society, University of Idaho, Moscow, ID 83844 USA (JUHE). **QUANTIFYING VISIBILITY AS A FUNCTIONAL PROPERTY OF WILDLIFE HABITAT: A NEW METHOD AND R PACKAGE**

The ability to assess the surrounding environment can influence animal fitness in multiple ways. For example, prey species can detect predators and take evasive action that increases probability of survival; animals can detect conspecifics and alter behaviors that either increase or decrease encounters with potential competitors or mates; and predators can locate potential prey and evaluate costs and benefits of pursuit. Habitat structure influences visibility of the surrounding environment (i.e., viewshed) continuously across a landscape. However, our ability to conduct viewshed analyses at scales that are meaningful to habitat selection by individuals has been limited by both structural measures of the environment and methods to quantify the spherical viewshed across a continuum of scales. Traditionally, photographic methods have been used to estimate visibility from a sample of directions and distances. Recent work (Olsoy et al. 2015) demonstrated that lidar data from terrestrial laser scanners (TLS) could provide a 3-dimensional model of vegetation within which visibility could be estimated. Our work provides a method for quantifying visibility in a spherical viewshed across continuous scales from any location in a landscape using lidar data to estimate habitat structure. We developed the R package viewshed3d (Lecigne and Eitel 2018) to quantify viewsheds in 3-dimensional habitats acquired with TLS. The main functions of the package are to quantify visibility by sampling the lidar point cloud in

every direction (i.e., sightline) from a user-defined location and to record the distance to the nearest obstruction in each direction. The other functions of the package prepare data prior to visibility calculation. We demonstrate these analyses from the perspectives of terrestrial and aerial animals, and we illustrate how this work can advance analyses of habitat selection. Understanding how habitat structure links functionally to both animal behavior and fitness provides a foundation for effective wildlife habitat management and restoration.

RANDALL, K. J.*[1], Ellison, M. J.[2, 3,] Johnson, T.N.[11] Department of Fish and Wildlife Sciences, University of Idaho, 875 Perimeter Dr. Moscow, ID 83844 [2] Department of Animal and Veterinary 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. **RESOURCE RESPONSES IN GREATER SAGE-GROUSE (*CENTROCERCUS UROPHASIANUS*) BROOD-REARING HABITAT TO LIVESTOCK GRAZING.**

Mesic meadows found in Idaho's sagebrush steppe provide a unique set of resources for wildlife habitat and livestock production. Greater sage-grouse (*Centrocercus urophasianus*), an Idaho Species of Greatest Conservation Need, rely upon these habitats during brood-rearing because they provide greater accessibility to developing forbs, an essential part of juvenile sage-grouse diets. Livestock grazing activities on mesic meadow plant communities and soils may elicit direct or indirect effects on sage-grouse populations reliant upon these communities. Understanding how livestock grazing impacts key habitat features of sage-grouse brood-rearing success will help inform management decisions to best provide for wildlife habitat and livestock production within mesic meadow systems. Managing the intensity and timing of livestock grazing in mesic meadows will be used to determine effects on sage-grouse brood-rearing habitat resources. Eight pastures will be established in two mesic meadow locations and stocked with yearling heifers. Short-duration grazing of four pastures at each location will be used to achieve either 30-40% grazing utilization (moderate) or 70-80% grazing utilization (high) in June (2-3 weeks), and again in August (2-3 weeks) on the other four pastures. Data will be collected before grazing, immediately after grazing completion, and at the end of September to assess forage regrowth. Cattle will be measured by body weight before grazing and post-grazing to evaluate performance and growth. Measures of vegetation composition and structure, foliar cover, grazing utilization, the average height of vegetation by species, biomass clippings, and soil moisture and water retention will be collected and compared against other sites where livestock grazing is unrestricted. Analysis of this data will provide greater insight into the relationship between livestock grazing and sage-grouse brood-rearing resources. Results may be used to guide future best management practices for livestock producers utilizing mesic meadow sage-grouse habitats.

DREW RETHERFORD*[1], Randy Larsen[1], Shane Roberts[2], Devin Englestead[3], Sara Norman[3], David Price[3], Chris Colt[4], and Jericho Whiting[5] [1]Brigham Young University, Provo, UT, 84602. [2]Idaho Department of Fish and Game, Idaho Falls, ID, 83401. Bureau of Land Management, Idaho Falls, ID, 83401. US Forest Service, Pocatello, ID, 83204. Brigham Young University-Idaho, Rexburg, ID, 83460. **FIDELITY AND MOVEMENTS OF FEMALE GREATER SAGE-GROUSE (*CENTROCERCUS UROPHASIANUS*) DURING BREEDING SEASON**

In recent years, greater sage-grouse (*Centrocercus urophasianus*, hereafter sage grouse) have become a species of concern in sagebrush steppe ecosystems. Each spring female sage grouse attend leks, or communal breeding grounds, where males display to compete for breeding opportunities. During the spring of 2015-2018, we attached GPS transmitters to 234 female sage grouse during breeding season in several locations in eastern Idaho. The purpose of our study is to quantify the size of area used while breeding, how many leks individual females attended each breeding season and fidelity to breeding areas and specific leks. To calculate the size of area used while breeding, we will generate a 95% KDE for each bird, each year. To quantify fidelity, we will overlay each year's 95% KDE and calculate the percentage of overlap. We expect female sage grouse will show fidelity to larger breeding areas, but little or no fidelity to specific leks. We also expect females to visit several leks while breeding. This research has important management implications for both state and federal agencies who manage sage grouse and their habitat, as well as initiatives aimed at improving private land for sage grouse.

ROBB, BRECKEN[1]*, Jessica Mitchell[3], Donna Delparte[2], Carolyn Dadabay[4], Peter Olsoy[5], Janet Rachlow[6], Lisa Shipley[5], Jordan Nobler[1], Marcella Fremgen[1], Chelsea Merriman[1], Graham Frye[7], Jack Connelly[6], Jennifer S. Forbey[1]. [1]Boise State University, [2]Idaho State University, [3]University of Montana, [4]College of Idaho, [5]Washington State University, [6]University of Idaho, [7]Alaska Cooperative Fish and Wildlife Research Unit. **REMOTELY-SENSING FUNCTIONAL CHEMICAL TRAITS OF NATIVE PLANTS ACROSS SAGEBRUSH-STEPPE LANDSCAPES.**

Landscapes are changing and under threat from anthropogenic activities, decreasing land cover, contaminated air and water quality, and climate change. These changes impact native communities and their functions at all spatial scales. A major functional trait being affected across these communities is nitrogen. Nitrogen supports plant nutrient cycling and growth, serves as an indicator for crude protein and productivity, and offers quality forage for wild and domestic herbivores. We need better ways to monitor nitrogen across space and time. Current monitoring is elaborate, time-consuming, and expensive. We propose drawing from agricultural methodologies to incorporate near infrared spectroscopy as a technique in detecting and monitoring nitrogen concentrations across a threatened shrub-steppe ecosystem. We are currently developing calibration equations for nitrogen in sagebrush across four species (*Artemisia tridentata wyomingensis, A. tripartita, A. arbuscula, A. nova*), three study sites and two seasons. Preliminary results suggest that nitrogen can be detected and accurately predicted across all sites, species, and seasons at varying degrees of certainty (R^2 0.75-0.90), as well as within combinations thereof. These results indicate that near

infrared spectroscopy offers a rapid, noninvasive diagnostic tool for assessing nitrogen in wild systems. This advancing technology is important because it economizes the collection of ecological data in rapidly changing landscapes and provides land managers and researchers with valuable information about the health and sustainability of their lands.

BETHANIE TWEDE*[1], Noelle Zenger[1], John Zenger[1], Jericho Whiting[1], Eric Billman[1], David Pennock[2], Devin Englestead[3]. Brigham Young University-Idaho, Rexburg, ID 83440[1]; Idaho Falls Zoo, Idaho Falls, ID[2]; Bureau of Land Management, Idaho Falls, ID[3]; Veolia Nuclear Solutions, Idaho Falls, ID[4]. **SUMMER ENTRY BY HUMANS INTO BAT ROOSTS IN THE SAND CREEK DESERT**

White-nose syndrome is caused by a fungus that kills many hibernating bats and can be spread by humans entering caves. Bats across the eastern US are dying from this fungus. This disease has been documented in the western US, however, it has not been recorded in Southeastern Idaho. Southeastern Idaho is an important location for bat roosting sites because of the many caves scattered throughout this area. Very little is known, however, about the types of human groups and frequency of those groups entering caves. We quantified human cave entry by setting motion-sensor cameras at six caves from May 30 to November 3, 2018. We quantified group type (hunters, cavers, and general public), number of individuals, and time spent in the caves. We recorded 19 groups (seven hunter groups, four caving groups, and eight general public groups) with a total of 48 individuals entering three of the caves. Because there was a large discrepancy in time spent in caves, we divided the cave entries into two categories (short duration was < 1 hour, and long duration was > 1 hour). The 14 groups in the short duration category were in caves for an average of 3.35 minutes (SD = 4.64, range = 1 to 19 minutes). The two groups in the long duration category were in the caves for an average of 112 minutes (SD = 15.56, range = 101 to 123 minutes). Our data will be used by the BLM to understand use of caves in the Sand Creek Desert and to help determine future cave use plans and education programs. Additionally, we are working with the Idaho Falls Zoo to educate the general public (the most prominent group type we recorded) regarding cave entry and the potential spread of white-nose syndrome.

J. Utz. Idaho Department of Fish and Game: Southwest Region, Nampa Idaho 83686.
RESTORATION OF RIPARIAN HABITAT IN THE OWYHEE MOUNTAINS THROUGH BEAVER TRANSLOCATION AND BEAVER DAM ANALOGS

The presence of American beaver (*Castor canadensis*) on a landscape can drive largescale hydrologic, geomorphic, and ecological processes. Recognition as an 'ecosystem engineer' species has led habitat managers and wildlife biologists to reintroduce beavers to drainages that historically supported, but no longer contain, beaver populations. Beavers in the Owyhee Mountains of southwest Idaho were trapped to near extermination during the 19th century, while modern stressors including juniper encroachment (*Juniperus occidentalis*) and climate change continue to degrade wetlands. To address damaged and shrinking Owyhee riparian habitats, the Southwest Region of the Idaho Department of Fish and Game has initiated a threefold beaver

management plan: translocating beaver to upland Owyhee drainages, installation of beaver dam analogs (BDAs) where beaver transplantation is not possible, and mitigation assistance for landowners whose land is already occupied by beaver. First, our beaver translocation protocol requires consideration of habitat capacity and potential for disease transmission. Live-trapped 'nuisance' individuals or family groups will be quarantined, washed thoroughly, and tracked via VHF tail tag transmitters. Second, where beavers cannot be translocated due to habitat restrictions or potential landowner conflict, BDA installation can mimic the effects of a beaver dam. BDAs slow soil erosion, recharge groundwater, encourage vegetation connectivity and diversity, and provide fish and amphibian habitat, among other benefits. BDAs may also encourage beaver recolonization by providing infrastructure for beavers to build upon. Finally, established beaver populations sometimes cause damage to private land through destructive damming, but beavers often rebuild dams that are breached or removed by humans. To mitigate negative effects, we installed pond levelers designed to increase water flow through existing dams while keeping overall dam structure in place. Through beaver reintroduction, BDA installation, and landowner conflict mitigation, we aim to restore and strengthen Owyhee upland riparian habitats.

NOELLE ZENGER*[1], Bethanie Twede[1], John Zenger[1], Jericho Whiting[1], Eric Billman[1], David Pennock[2], Devin Englestead[3]. Brigham Young University- Idaho, Rexburg ID 83440[1]; Idaho Falls Zoo, Idaho Falls, ID[2]; Bureau of Land Management, Idaho Falls, ID[3]. **DISTRIBUTION AND HABITAT USE OF THE ST. ANTHONY DUNES TIGER BEETLE.**

The St. Anthony Dunes tiger beetle (*Cicindela arenicola* Rumpp) occurs exclusively on a few dune systems in the Snake River Plain in Idaho, and one location in southern Montana. *C. arenicola* is considered a type 2 sensitive species by the Bureau of Land Management in Idaho. In 2018, we reexamined density and distribution of adults and larval burrows within the St. Anthony Dunes and compared those with findings from a 2013 study. We also examined the density and distribution of beetles in historical dune habitats in Idaho Falls. Additionally, we monitored larval burrowing activity by temperature and identified habitat used by larvae in those areas. Distribution of tiger beetles has increased slightly from 2013 to 2018 in the St. Anthony Dunes and beetles were recorded in historic habitat in Idaho Falls. Populations of *C. arenicola* were in all habitats, regardless of human activity, but we observed a unique pattern with larval activity that warrants further study. We also documented that beetles in the St. Anthony and Idaho Falls dunes use different habitat. Our data are some of the first to document the distribution and activity of these beetles across years and will be used by the Bureau of Land Management for the conservation of this endemic species and its habitat.