2020 Idaho chapter of the wildlife society

"BALANCING IDAHO'S POPULATION GROWTH WITH WILDLIFE CONSERVATION NEEDS"

9-12 March 2020

Best Western University Inn

Moscow, Idaho

ABSTRACTS

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FULL ORAL PRESENTATION ABSTRACTS

**Denotes Student Presenter*

ALSUP, STEVEN[1], J. Belthoff[1], T. Katzner[2], K. Steenhof[2], M. Kochert[3]. [1]Raptor Research Center, Boise State University, Boise, Idaho 83705; [2]Owyhee Desert Studies, Murphy, Idaho, 83650; [3]U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Boise, Idaho, 83706. ABUNDANCE AND NESTING SUCCESS OF PRAIRIE FALCONS (*FALCO MEXICANUS*) IN THE MORLEY NELSON SNAKE RIVER BIRDS OF PREY NATIONAL CONSERVATION AREA.

The Morley Nelson Snake River Birds of Prey National Conservation Area (NCA) supports one of the world's highest known densities of nesting Prairie Falcons. The NCA is thought to support ~5% of the global population of Prairie Falcons, and the boundaries of the NCA were established based, in part, on a telemetry study documenting the foraging range of falcons nesting in the Snake River Canyon. Prairie Falcon abundance and reproductive performance has been studied intermittently in the NCA over the past 45 years, but no formal surveys have been conducted there since 2003. As a consequence, the Prairie Falcon was identified by agency and university biologists in 2008 as a priority species for monitoring. In summer 2019, we assessed prairie falcon abundance in the Snake River Canyon by systematically surveying 50 km of river, in 5 km segments, during two rounds of occupancy surveys. We randomly selected 50 historical nesting territories and documented nesting success to assess reproductive performance. Preliminary results suggest that the number of occupied territories (n=130) were well above those reported within the same 5-km stretches in 2002 (n=85) and 2003 (n=75). However, nesting success per occupied territory (44%) was one of the lowest rates reported (1974-1997 average = 63%; 2002 = 58%; 2003 = 42%), and success varied across the four traditional study strata in the NCA. Despite the low reproductive success, because of the large number of nesting attempts, the number of nests that fledged offspring was higher than in earlier surveys. These results highlight the importance of long-term monitoring efforts for the management and conservation of this species.

AUSBAND, DAVID. U.S. Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit, Moscow, Idaho 83844. MONOGAMY; IT'S COMPLICATED. BREEDING STRATEGIES IN GRAY WOLVES.

Breeding strategies of cooperative breeders can vary widely ranging from multiple breeding pairs in a group, to polygamy, polyandry, and combinations of all 3 forms. Often, we do not have a clear understanding of the influences or mechanisms giving rise to the presence of multiple breeding individuals within groups. I examined factors associated with the occurrence of multiple breeding individuals within groups in a population of recolonizing gray wolves (*Canis lupus*) in Idaho and Yellowstone National Park, Wyoming, United States. High wolf density and large group size were both associated with a significant increase in the frequency of multiple breeding females in a group. Multiple breeding can also take the form of polyandry, and "sneaker" males were responsible for paternity in nearly 13% of pups born. I also wanted to

assess the influence of breeding pair bond duration on the prevalence of such multiple breeding. Through genetic sampling and pedigrees, I found that increasing pair bond duration yielded significant benefits to breeders through increased survival of young and this effect was stronger than group size. Additionally, increased pair bond duration was associated with a dampening in the prevalence of other alternative mating strategies such as sneaker males and polygamy. Breeding strategies in this social carnivore may be more variable than previously assumed, but their occurrence can be predicted by group size and density. The selective advantage of alternative mating strategies is a combination of population, group (for applicable species), individual, and social influences such as pair bonds. The distribution of pair bonds in a monogamous population affects the selective advantage, and hence frequency, of various mating strategies observed.

BERG, JODI[1,2], S. Bergen[3], M. Hurley[4], and M. Kauffman[2]. [1]Idaho Department of Fish and Game, Lewiston, Idaho 83501; [2]Wyoming Cooperative Fish and Wildlife Research Unit, Laramie, Wyoming 82071; [3]Idaho Department of Fish and Game, Pocatello, Idaho 83204; [4]Idaho Department of Fish and Game, Boise, Idaho 83712. MAPPING MULE DEER MIGRATIONS: AN UPDATE ON IDAHO'S APPROACHES AND RESULTS.

The Department of Interior Secretarial Order 3362 directed the 11 western states, including Idaho, to identify, conserve, and restore priority migratory corridors for big game. Accurately predicting animal movement across the landscape requires relatively frequent relocation data, yet Idaho has relied on 13-hr GPS fix rates in recent years. Using a combination of 'traditional' Brownian bridge and newly developed Forced Motion Variance movement models, we used a variety of GPS fix rates from collar data spanning the years 2002 – 2018 to map the migrations and stopovers of 12 mule deer populations across central and southern Idaho. Our results will aid managers by pinpointing areas used by animals when moving to and from seasonal ranges, and by determining dates of arrival and departure from stopover areas, thus helping gain more understanding of habitat used during critical periods (*e.g.*, fawning and rut). Future work will extend to Idaho's priority elk populations and to making data and map layers easily accessible by managers via web-based applications.

BERGEN, SCOTT, J. Berg, and M. Hurley. Idaho Department of Fish and Game, Pocatello, Idaho 83204. DECONSTRUCTING UNGULATE MIGRATIONS IN IDAHO. DOES EMPIRICAL LOCATION DATA SUPPORT POPULATION STOPOVER DELINEATIONS?

Under Secretarial Order 3362, the Dept. of the Interior has promoted analysis of mule deer, elk and pronghorn antelope across the 11 western states. In 2018, USGS scientist coordinated the development of established methodologies to provide these western states with a roadmap for estimating and delineating population level migration routes. Within this framework, population level migration routes are comprised of 'corridors' of fast transit interposed by less vagile stopover locations, where individuals forage and rest. Past studies have used Brownian Bridge Movement Models (BBMM) to identify migration routes in their entirety, as well as deconstructing these paths into corridors and stopover locations of an individual's single seasonal migration. In the methods proposed by USGS, BBMM individual seasonal migration

data derivatives are assembled and numerically combined for the purposes of identifying population (winter herd) migration routes and their proportion of use. Likewise, USGS's stopover population level estimate uses accumulated BBMM derivatives prior to delineating their location. In this Talk, we will empirically evaluate how well population level migration corridors and stopovers work using the USGS population methods across the species identified within SO 3362. To do so, we will use individual seasonal migration analysis using BBMM techniques and trajectory analyses (Calenge 2019, Guéguen 2001) to deconstruct individual migrations and evaluate the performance of USGS population level migration analysis. Methodological and management implications will be discussed for each of the species covered by the secretarial order.

BILODEAU, NICOLE*[1], F. Cassirer[2], L. Shipley[3], S. Gilbert[1], and R. Long[1]. [1]University of Idaho, Moscow, Idaho 83844; [2]Idaho Department of Fish and Game, Lewiston, Idaho 83501; [3]Washington State University, Pullman, Washington 99164. LINKING NUTRITION TO BEHAVIOR AND LAMB SURVIVAL OF BIGHORN SHEEP.

Bighorn sheep populations have declined significantly throughout their historic range since the 1900's, and many have even been extirpated due to unregulated harvest, habitat fragmentation, and the introduction of respiratory disease. For over half a century, wildlife managers have attempted to mitigate the decline by restricting harvest, implementing habitat restoration and translocation efforts, and managing risk of disease transmission. Although these efforts have been successful in some instances, respiratory disease continues to limit bighorn recovery, creating a challenge for managers. Previous studies have shown that nutritional condition has profound effects on the physiology and productivity of ungulates. Yet, the extent to which nutrition limits the success of bighorn sheep in Idaho remains poorly understood. We sought to determine how variation in the nutritional landscape influenced bighorn movement, habitat selection, and lamb survival. We conducted intensive habitat sampling and lamb summer (May–September) survival surveys in 3 study areas 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 study area, collected biological samples and quantified body condition and reproductive status using ultrasonography and manual palpation. We monitored a total of 140 ewes to quantify patterns of habitat selection and lamb survival during the summer. Preliminary results indicate that dam body condition was a significant, positive predictor of summer lamb survival whereas mass was not. Our study highlights mechanistic relationships between habitat use, nutrition, and bighorn sheep vital rates in Idaho.

BLAKE, WILLIAM[1], J. Carlisle[2], J. Halka[2], and K. Stone[1]. [1]MPG Ranch, Missoula, Montana 59801; [2]Intermountain Bird Observatory, Boise State University, Boise, Idaho 83725. IDAHO EXPANSION OF THE MOTUS WILDLIFE TRACKING SYSTEM.

Wildlife movement, including migration, influences the ability for species to adapt and survive. Despite recent advances in tracking technologies, movement ecology remains understudied for most species, especially for small wildlife. Without a better understanding of movement, conservation strategies for many species may not reflect full annual cycles. The Motus Wildlife

Tracking System, or Motus, helps to fill that void by deploying digitally encoded VHF tags on wildlife, in combination with strategic placement of automated receiving units, called Motus stations. The successful tracking of Motus tags is dependent upon the number and placement of Motus stations. While Motus is most active in eastern North America, there has been little investment in the West. In 2018, Partners In Flight, a professional group of avian researchers and conservationists, introduced "The Western Motus Network" initiative, to plan the strategic placement of future Motus stations and address large scale questions for migration of birds across the West. This year MPG Ranch, based in western Montana, joined Partners In Flight to lead the expansion of Motus across the Intermountain West Flyway. MPG Ranch and local researchers established a network of 12 Motus stations and tagged 120 birds and bats. Today, the Intermountain Bird Observatory is partnering with MPG Ranch to expand this network into Idaho. Already, we've installed one station near Boise, ID and plan to continue from east to west by installing up to 15 stations along the Snake River corridor. This collaborative project will allow the first of a kind opportunity to study species' migration across Montana and Idaho. Motus data will provide information on key life-history traits, such as dispersal, survival, departure and arrival dates, and a better understanding of full annual cycles. We hope this Motus project will eventually lead to new research collaborations in Idaho and across the West.

CAMPOS, PHILIP*[1], M. Lucid[2], and J. Walke[1]. [1]Eastern Washington University, Cheney, Washington 99004; [2]Idaho Department of Fish and Game, Coeur d'Alene, Idaho 83814.
IMPACT OF CHYTRID FUNGUS PATHOGEN ON SKIN MICROBIOME OF COLUMBIA SPOTTED FROGS IN NORTHERN IDAHO.

Chytridiomycosis, an emerging infectious disease caused by the chytrid fungus *Batrachochytrium dendrobatidis* (Bd), is associated with an estimated 501 population declines and 90 extinctions of amphibian species worldwide, the greatest documented loss of biodiversity attributed to a disease. Research on the amphibian skin microbiome may provide solutions to conservation of amphibian species by bettering our understanding of 1) Bd's effect on the skin's microbial community composition and 2) the effects of microbial community composition in protection against Bd. Our goal is to investigate correlations between the Bd prevalence/intensity and microbial community composition in local populations to potentially identify differences in the microbiomes of infected and uninfected frogs. DNA samples from skins of 399 Columbia spotted frogs (*Rana luteiventris*) were obtained by the Idaho Department of Fish and Game in 2013-2014. Frogs were sampled from a total of 153 wetlands in northern Idaho, with Bd being detected on frogs in 80% (n = 123) of the sampled wetlands. Of the 399 spotted frogs tested for Bd presence, 65% (n = 261) tested positive, 29% (n = 115) negative, and 6% (n = 23) equivocal. The average infection intensity was low, with zoospore equivalents ranging from 0 to 98.8. To test for differences in the skin microbiomes of infected and uninfected frogs, the microbial community composition will be characterized using amplicon barcoded sequencing of the V4-V5 region of the 16S rRNA gene. We expect to see differences in the proportion of antifungal microbes, which could possibly explain the low zoospore equivalents observed. Our results suggest that Bd is prevalent, but at low infection intensities, among Columbia spotted frogs in northern Idaho.

CARR, AMANDA, and S. Thompson. Idaho Department of Fish and Game, Boise, Idaho 83712.
CAN AI HELP RELIEVE THE WORKLOAD OF CAMERA TRAP IMAGES?

Camera traps offer a noninvasive, low-risk method for monitoring wildlife populations. However, remote camera deployments can yield millions of photos over a single field season, rendering timely data processing infeasible. Big technology companies boast advancements in image recognition technology using artificial intelligence (AI), but few wildlife research groups have integrated AI into their photo processing workflow. Moreover, the assumed AI benefits of reduced processing time and error rates have not been shown for a large-scale wildlife research project. In 2019, Idaho Department of Fish and Game integrated the "mega-detector" developed by Microsoft AI for Earth into a deployment of almost 600 cameras, which generated approximately 12 million photos over 4 months. For cameras with both motion- and time-triggered photos, the mega-detector reduced the number of photos viewed by humans to roughly 10% of the original set. To objectively compare the processing time and error rates with and without the assistance of AI, we used a stratified random sampling design to select 10 cameras for additional processing. Each camera was viewed by four different people: two with AI image recognition assistance, and two without AI. Preliminary results suggest that using AI image recognition reduced processing time by about 40%, with an average false negative rate (i.e., photos incorrectly marked "empty" by AI) of about 3%. However, both processing time and AI error rates varied as a function of habitat and deployment type (i.e., whether the camera took time- and motion-triggered photos or only motion-triggered photos). Based on current AI capabilities, our results suggest that some, but not all, camera trap projects may benefit from incorporating AI image recognition into their photo processing work flow.

CASSIRER, FRANCES[1], T. Besser[2], R. Plowright[3], K. Manlove[4], B. Felts[5], T. Garwood[5], J. Jenks[5], M. Cox[6], P. Cross[7], A. Dobson[8], J. Hogg[9], P. Hudson[10], M. Jeffress[11], C. Lehman[12], A. Lisk[13], P. Matthews[14], L. Weyand[2], P. Wik[15], P. Wolff[6], and D. Walsh[16]. [1]Idaho Department of Fish and Game, Lewiston, Idaho 83501; [2]Washington State University, Pullman, Washington 99163; [3]Montana State University, Bozeman, Montana 59717; [4]Utah State University, Logan, Utah 84322; [5]South Dakota State University, Brookings, South Dakota 57007; [6]Nevada Department of Wildlife, Reno, Nevada 89512; [7]U.S. Geological Survey, Northern Rocky Mountain Research Center, Bozeman, Montana 59717; [8]Princeton University, Princeton, New Jersey 08544; [9]Montana Conservation Science Institute, Missoula, Montana 59803; [10]Pennsylvania State University, State College, Pennsylvania 16801; [11]Nevada Department of Wildlife, Elko, Nevada 89801; [12]South Dakota Department of Game, Fish, and Parks, Custer, South Dakota 57730; [13] U.S. Fish and Wildlife Service, Moiese, Montana 59824; [14]Oregon Department of Fish and Wildlife, Enterprise, Oregon 97828; [15]Washington Department of Fish and Wildlife, Clarkston, Washington 99403; [16]U.S. Geological Survey, National Wildlife Health Center, Madison, Wisconsin 53711. BIGHORN EWE INFECTION STATUS IS KEY TO UNDERSTANDING AND MANAGING PNEUMONIA IN LAMBS.

Spillover of the bacterium *Mycoplasma ovipneumoniae* (Movi), can have long term negative demographic impacts on bighorn sheep (*Ovis canadensis*) populations, principally through chronically low lamb recruitment associated with pneumonia-induced mortality. Remarkably, despite the devastating respiratory disease epidemics often observed in all age classes on first

exposure to Movi, most survivors eventually clear infection. Prevalence of Movi shedding by adults in exposed bighorn sheep populations is usually low (median 22%) and many shed only intermittently. However, some individuals are unable to resist infection and become persistent carriers. We conducted experiments in free-ranging and captive bighorn sheep to test the hypothesis that recurring pneumonia epidemics in lambs are triggered when persistent carrier dams transmit Movi to lamb nursery groups. We tested individual sheep repeatedly over at least two consecutive years in two captive research facilities and four free-ranging populations presenting lethal pneumonia in lambs to identify intermittent and persistent carriers of Movi. We then removed persistent carriers from free-ranging populations and conducted captive lamb survival trials in pens with and without persistent carriers. We observed no respiratory disease and increased lamb survival in populations and pens without carrier ewes, whereas high rates of lamb morbidity and low survival were observed in populations and pens with carrier ewes. We also identified cofactors that may contribute to variation in shedding prevalence and persistence. The results of these experiments support the hypothesis that persistent carriers maintain Movi infection in bighorn sheep populations and are the cause of recurring pneumonia epidemics in bighorn lambs. These results have important implications for the epidemiology and management of chronic pneumonia in wild sheep populations.

CONWAY, COURTNEY[1,2], T. Wellicome[3], and C. Lundblad[2]. [1]U.S. Geological Survey, Idaho Cooperative Fish & Wildlife Research Unit, Moscow, Idaho 83843; [2]University of Idaho, Moscow, Idaho 83843; [3]Canadian Wildlife Service, Edmonton, Alberta, Canada. MIGRATION BEHAVIOR OF WESTERN BURROWING OWLS THROUGHOUT NORTH AMERICA.

Identifying causes of population declines in migratory animals is difficult for species for which we know little about their migratory routes and wintering locations. Western burrowing owls (*Athene cunicularia hypugaea*) are a species of national conservation concern in the U.S. and are federally endangered in Canada. The cause(s) of population declines in burrowing owls are not known and we know little about their migration patterns. To address this gap, we have deployed solar-powered satellite transmitters (PTTs) on >90 adult owls in 9 U.S. states and 3 Canadian provinces from 2013-2019. We obtained data for 34 complete southward migrations, linking breeding sites in Canada and the U.S. to wintering sites in the U.S. and Mexico. Most burrowing owls that bred in the interior states and provinces wintered in mainland Mexico but most owls the bred west of the continental divide wintered in California and Baja California. Burrowing owls that bred in Idaho migrated to Mexico. Owls varied greatly in the timing of migration and the time spent migrating. Most owls that bred on the Great Plains funneled through western Texas when migrating southward. Over 90% of the owls that nested in (and migrated from) Colorado, Wyoming, South Dakota, Nebraska, and Montana took a multi-day break from migration in northwestern Texas (with most of these stopovers near Lubbock, Texas). Mexico and California are important wintering areas for western burrowing owls and our results identify important stop-over and wintering locations where conservation efforts might be focused.

COONS, SHEA*[1], V. Dreitz[1], and P. Donnelly[2]. [1]Avian Science Center, University of Montana, Missoula, Montana 59812; [2]US Fish and Wildlife Service, Missoula, Montana 59812.
WETLAND DYNAMICS AND CONSERVATION ACROSS THE INTERMOUNTAIN WEST: RELATIONSHIPS WITH WHITE-FACED IBIS (PLEGADIS CHIHI).

Little is known regarding how wetland resources shape white-faced ibis populations (Plegadis chihi; hereafter 'ibis') across the landscape. Addressing this paucity of information is essential for understanding ibis ecology and informing management actions. My specific objectives are to 1) determine trends in wetlands used by white-faced ibis breeding colonies across the Intermountain West from 1984 to 2018 and their potential drivers, then 2) assess how these trends in wetlands influence fluctuations in white-faced ibis breeding colony numbers. I will use Google Earth Engine to run a constrained spectral mixture analysis on Landsat imagery to measure annual surface water extent at known colony sites during the ibis breeding season (May-September). I will then determine changes in wetland flooding and, accordingly, ibis habitat availability by comparing annual surface water areas over time. Additionally, I will also identify and analyze climatic and anthropogenic variables to assess the primary drivers of wetland flooding. I will collect ibis breeding colony locations and adult counts through literature reviews and contacting federal, state, and other wildlife agencies in Idaho and other states within the Intermountain West. I will then examine the correlation between ibis colony counts and wetland trends to investigate how colony numbers are changing in relation to wetland dynamics across the region. This study will be the first to highlight how water surface area has been evolving in the Intermountain West and identify subsequent implications for wetland plasticity, allocation of wetland resources for human use, and ibis population persistence.

CURTIS, RACHEL[1], N. Bilodeau[2], F. Cassirer[3]. [1]Idaho Department of Fish and Game, Nampa, Idaho 83687; [2]University of Idaho, Moscow, Idaho 83844; [3]Idaho Department of Fish and Game, Lewiston, Idaho 83501. CALIFORNIA BIGHORN SHEEP DISEASE MONITORING, SURVIVAL, AND HABITAT USE IN OWYHEE RIVER WILDERNESS, OWYHEE COUNTY, IDAHO.

Disease was an important factor contributing to the extinction of bighorn sheep in much of their range, and pneumonia continues to limit bighorn sheep numbers. In late 2015, Leslie Gulch, Oregon suffered a severe pneumonia outbreak in a population with known connectivity to populations in Idaho. Starting in March 2016, the Idaho Department of Fish and Game began to capture and test bighorn sheep for pneumonia over three years, and placed GPS transmitters on sheep in the Owyhee Front and the Owyhee River Wilderness. We collected samples for health assessments on captured sheep to determine disease prevalence. Although the pneumonia outbreak did not spread into Idaho, we determined other causes of mortality for dead collared sheep, collected samples, and ultimately calculated survival and mortality rates. We were able to determine habitat use areas, home ranges, and migration routes using GPS collar data, which allowed us to quantify space use and compare the home ranges to local landscape features and identify possible barriers or features that may alter movement and habitat use. This project has opened a window to sheep habitat use in these units, and helped us understand the disease risk of this population.

DUDKO, JONATHAN*, and D. Delehanty. Idaho State University, Pocatello, Idaho 83209. EFFECTS OF HUMAN RECREATIONAL TRAIL NETWORKS ON WILDLIFE DISTRIBUTION IN A WESTERN FOREST.

As the western United States becomes increasingly developed and urbanized, wildlife and wild spaces are threatened by encroaching disturbances that may influence the abundance and distribution of flora and fauna. These disturbances may be especially pronounced at the wildland/urban interface where recreational trails occur at greater densities and are used at greater rates than in isolated areas. This project was designed to describe the interactions between human recreational disturbances and wildlife responses (i.e. altered abundance or distribution) at the species and community levels. These descriptions were accomplished through direct measures of human use of the landscape and in an information theoretic modeling approach using occupancy data from avian and mammalian communities.

EDELMANN, FRANK. Idaho Department of Fish and Game, Boise, Idaho 83707. IMPLEMENTATION OF IDAHO's ACTION PLAN FOR SECRETARIAL ORDER 3362: IMPROVING HABITAT QUALITY IN WESTERN BIG-GAME WINTER RANGE AND MIGRATION CORRIDORS.

Big game species are important to both the cultural heritage and economies of communities across the West. Challenges conserving big game populations are increasing as society seeks to balance wildlife conservation with development for growing human populations. Highly mobile big game populations migrating between distant seasonal ranges exacerbate these challenges. In response, Secretarial Order No. 3362 (SO3362) directs the Department of Interior to assist western tribes, private landowners, state fish and wildlife agencies, and state highway departments with conserving and managing priority big game winter ranges and migration routes. SO3362 also recognizes the cultural and economic significance of robust and sustainable big game populations. To implement SO3362, the Idaho Department of Fish and Game (IDFG) led development of the "Idaho Action Plan" in 2018, which was followed by an update in 2019. The Action Plan identifies five Priority Areas and corresponding management actions for pronghorn, mule deer, and elk winter range and migration routes. Action Plan recommendations include technical assistance, research, habitat management, conservation easements, and transportation mitigation. During 2018 and 2019, IDFG collaborated with an array of partners (e.g., state and federal agencies, non-governmental organizations, and private landowners) to implement Action Plan projects with SO3362 funding. I will summarize key SO3362 projects to illustrate benefits realized through SO3362 and Idaho's Action Plan.

GARTON, OZ. University of Idaho, Moscow, Idaho 83843. WHY HAVE POPULATION CYCLES IN GREATER SAGE-GROUSE IN THE SNAKE RIVER PLAINS DISAPPEARED WHILE POPULATIONS FELL PRECIPITOUSLY IN ABUNDANCE?

Reconstructed population abundance estimates from Greater Sage-grouse lek counts conducted from 1967 to 2013 appear to show cyclic population patterns of the classic 8-10 year wildlife cycle from 1967 to 1996 that disappeared after 1996. Overall this population declined by 550

males counted per year falling almost 90% from over 26,000 males in 1969 to 3100 males in 1996. Since then the population has fluctuated from 3,000 to 6,000 males counted at leks with little apparent periodicity. I tested these population estimates statistically for evidence of a declining trend and cyclic population changes. I tested 4 scientific hypotheses concerning their causes including sun-spot cycles, increased drought and fire frequency resulting from climate change, as well as changes in grazing on public lands.

GERMINO, MATTHEW[1], and J. Pyron[2]. [1]U.S. Geological Survey, Boise, Idaho 83706; [2]U.S. Fish and Wildlife Service, Boise, Idaho 83709. AFTER THE SODA FIRE: WHAT HAVE WE LEARNED AND HOW CAN WE APPLY IT IN THE FUTURE.

In 2015, the Soda Fire burnt nearly 280,000 acres of sagebrush steppe habitat in the Owyhee uplands of southwestern Idaho and southeastern Oregon. Combinations of various land treatments were implemented to address numerous resource concerns across a highly variable topography. To improve adaptive management of post-fire treatments and land use, intensive monitoring was deployed on over 2000 plots. Data gathered from these plots has been used to make more informed decisions within the Soda Fire landscape. We will discuss key lessons learned, whether this approach applicable to future post-fire response, and additional policy implications.

GILBERT, SOPHIE[1], K.J. Hundertmark[2], M.S. Lindberg[2], D.K. Person[3], and M.S. Boyce[4]. [1]University of Idaho, Moscow, Idaho 83844; [2]University of Alaska Fairbanks, Fairbanks, Alaska 99709; [3]Alaska Department of Fish and Game (Retired), Braintree, Vermont 05060; [4]University of Alberta, Edmonton, Alberta, Canada. THE IMPORTANCE OF ENVIRONMENTAL VARIABILITY TO POPULATION DYNAMICS FOR A LONG-LIVED NORTHERN UNGULATE.

The pathways through which environmental variability affects population dynamics remain poorly understood, limiting both ecological inference and management actions in the rapidly-changing modern world. Here, we develop models of vital rates and matrix-based population dynamics to examine the effects of environmental variability and individual traits. Using Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) in Southeast Alaska as a study system, we modeled effects of environmental and individual predictors on female survival, pregnancy rate, and fetal rate, as well as summer and winter fawn survival. To examine the influence of process variance on population dynamics, we a) perturbed vital rates by the observed level of process variance, b) perturbed a range of matrix models representing annually variable vital rates to explore transient and asymtotic population responses. We found adult female survival was the most influential vital rate based on classic elasticity analysis, however elasticity analysis of transient dynamics indicated that fawn survival was most influential during negative perturbations, and stage structure had a strong potential influence (but less strong likely real-world influence) on transient population size. Summer fawn mortality was primarily determined by black bear predation, and was positively influenced by mass at birth and female gender. Winter fawn survival was determined by malnutrition in deep-snow winters, and was influenced by date of birth and snow depth, with late-born fawns at greater risk in deep-snow winters.

Integrating the effects of covariates on vital rates and population growth and including transient dynamics, as we do here, is important for populations that are frequently perturbed by environmental or management conditions and therefore seldom at their stage stage distributions.

GROTH, KAYTE*[1], J. Horne[2], S. Gilbert[1], and R. Long[2]. [1]University of Idaho, Moscow, Idaho 83844; [2]Idaho Department of Fish and Game, Lewiston, Idaho 83501. SUMMER HABITAT SELECTION OF WHITE-TAILED DEER: CAN WE REDUCE CROP DEPREDATIONS IN NORTHERN IDAHO?

In the Clearwater region of northern Idaho, white-tailed deer (WTD) cause significant damage to high-value agricultural crops. However, despite these ongoing and significant damages, few successful deterrents have been identified. To meet this need, our project examined WTD habitat selection throughout the crop-growing season and deployed 2 types of deterrents, each designed to modify behavior and reduce the use of agricultural fields. Our treatments consisted of a fear-enhancing deterrent (a combination of 3 components that targeted auditory, olfactory, and visual cues) and a physical exclusion deterrent (4-strand electric fence). Deployment sites for the fear-enhancing treatment were chosen by using GPS-locations from collared individuals that delineated high-use areas along canyon/agricultural field interfaces. Agricultural fields that received an electric fence were chosen according to crop type (pulse crops only) and length of the canyon/field interface (<1 mile). A total of 7 fields were treated (4 fields treated with the fear-enhancing deterrent and 3 fields that were fenced), and treatments were operated on weekly intervals throughout the crop-growing season, alternating between treatment and no-treatment periods. We plan to analyze the efficacy of these treatments by quantifying changes to space use and comparing movements between pre- and post-treatments. We also intended to evaluate a taste-aversion deterrent, lithium chloride (LiCl). However, LiCl has yet to be implemented as a deterrent treatment in an open field setting and many key issues regarding toxicity and withdrawal times in muscle tissues needed to be addressed before implementation. To address these issues we conducted a series of feeding trials with a surrogate ungulate (domestic sheep), investigating withdrawal times and toxicity at varying amounts of ingested LiCl over a 10-day period. Although we were not able to actively deploy LiCl in a field setting and determine its efficacy as a deterrent treatment, we offer suggested withdrawal times in an effort to guide future research projects in doing so.

GUTHRIE, JOHN*[1,2], S. Gilbert[1], and S. 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 this 2-year study, 70 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 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. 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.

HARJU, SETH[1], and C. Olson[2]. [1]Heron Ecological, LLC, Kingston, Idaho 83839; [2]HWA Wildlife Consultants, LLC, Laramie, Wyoming 82070. SPATIO-TEMPORAL PATTERNS IN ASSIMILATED DIETS IN NESTLINGS OF A GENERALIST AVIAN PREDATOR, THE COMMON RAVEN.

Common ravens (*Corvus corax*) are a generalist avian predator responsible for a wide variety of human-wildlife conflicts, including impacts on greater sage-grouse (*Centrocercus urophasianus)* populations via depredation of sage-grouse nests. We conducted a stable isotope diet study to partition assimilated diets of 179 raven nestlings from 95 nests to determine spatio-temporal patterns in nestling diets as provisioned by their parents. Spatial heterogeneity was the primary driver (66.8%) of variation in δN15 whereas temporal heterogeneity was the primary driver (60.3%) of variation in δC13. Herbivore carrion was the primary assimilated diet item for raven chicks (~50-65%), followed by human food sources (10-35%), avian (i.e., sage-grouse) chicks and eggs, insects, and plants. The proportion of diet derived from herbivore carrion decreased from 70.2% to 47.7% with increasing distance from highways/railroads. The proportion of nestling diets comprised of avian chicks/eggs declined by a factor of 0.869 for every kilometer further that the raven nest was from an active sage-grouse lek. These results suggest that raven chick diets are driven by spatio-temporal patterns, but consist primarily of items potentially subsidized by humans. Potential impacts on sage-grouse nesting success are likely heightened when anthropogenic nesting substrates are located nearer to active sage-grouse leks, providing a potential mechanism for targeted management actions.

HENRY, ADONIA[1], A. Kristof[2], J. Warren[3], and J. Barnett[4]. [1]Scaup & Willet LLC, King Salmon, Alaska 99613; [2]Camas National Wildlife Refuge, Hamer, Idaho 83425; [3]U.S. Fish and Wildlife Service, Inventory and Monitoring Program, Lima, Montana 59739; [4]U.S. Fish and Wildlife Service, Inventory and Monitoring Program, Portland, Oregon 97232. HOW A STATE-AND-TRANSITION MODEL CAN IMPROVE WETLAND MANAGEMENT.

Historical ecological processes and functions of wetlands in the arid and semi-arid northern Intermountain West and western Prairie Pothole regions (IWPPR) have been highly modified by diversion of water from and/or storage of water in wetlands. As a result, management and/or restoration actions are required to maintain ecological processes that support dynamic habitat conditions and biological communities. Few tools are available to understand the effects of

management actions and the expression of wetland plants, particularly submerged aquatic vegetation. Well developed for rangeland systems and shallow lakes, state-and-transition models (STMs) are rarely used for wetland management and shallow lake models do not include emergent vegetation in the littoral zone. We developed a broad-scale, regional STM for semipermanent wetlands and shallow lakes in the IWPPR to link ecological processes and function to measurable indicators of vegetative structure and composition. The STM includes one reference state with seven phases encompassing the natural range of variability of vegetation communities and hydrologic conditions for emergent and submerged aquatic habitats. Three alternative states were identified where altered ecological processes have degraded vegetation communities and positive feedback loops prevent them from returning to the reference state. We assessed submerged aquatic and emergent vegetation, hydroperiod characteristics, and soils at 54 wetlands across 12 national wildlife refuges from 2014 to 2017. We developed vegetative indicators of each state and phase based on abundance, growth form, seral state, and species assemblage and hypothesized threshold values. We calculated hydroperiod variables for multiple years that will inform how current and prior-year hydrologic conditions influence submerged aquatic and emergent vegetation communities across multiple spatial and temporal scales. The STM provides an adaptive framework to inform management and restoration to successfully achieve habitat-based objectives for wetland-dependent wildlife and increase resilience of wetlands to future changes in ecological processes.

HERNANDEZ, MAURO, and T. Stefanic. Craters of the Moon National Monument and Preserve, Arco, Idaho 83213. INVENTORY AND MONITORING OF BAT MATERNITY COLONIES ON CRATERS OF THE MOON NATIONAL MONUMENT AND PRESERVE AND SURROUNDING AREA (WHAT WE LEARNED IN YEAR 1).

We monitored 20 caves in 2019 for evidence of bat maternity colony use. Six historic maternity colony sites and 14 caves suspected to have potential to house maternity colonies. We deployed HOBO data loggers and guano collection boxes in these caves before the start of the maternity season. During the maternity season we used a digital boroscope to view bats in these caves without having to enter and disturb maternity colonies and acoustic detectors to capture bat calls at the cave entrances. We conducted out flight surveys at these caves using a night vision camera with an infrared kit. We confirmed several historic Townsend big-eared bat (*Corynorhinus townsendii*) maternity colonies were active in 2019 and discovered 3 new western small-footed myotis (*Myotis ciliolabrum*) maternity colony sites. We have much call data and video to analyze and guano has yet to return from the lab with species identifications but we will discuss what worked, what didn't and where we go from here.

HORNE, JON, and S. Thompson. Idaho Department of Fish and Game, Boise, Idaho 83712. CAN WE ESTIMATE NEONATE SURVIVAL WITH REMOTE CAMERAS? YES WE CAN!

In many western states, wildlife managers are grappling to understand the dynamics of multiple-predator, multiple-prey systems. An important component of this understanding is estimating neonate mortality and understanding causes of variation. However, traditional field methods are

economically and logistically challenging; usually involving capture of pregnant adults, installing vaginal implant transmitters (VITs), finding neonates in the field, and intensive monitoring of neonates for mortalities. These challenges often prevent long-term studies of neonate survival over large spatial scales, inhibiting our ability to understand complex predator-prey dynamics. With the burgeoning use of camera traps for monitoring wildlife populations, we were interested in whether picture data from cameras could be used to estimate summertime neonate survival as this would offer a relatively inexpensive alternative to traditional methods. We developed a Bayesian estimation model that describes the expected ratio of adult to neonate pictures as a function of (1) the survival function for adults, (2) the parturition rate of adults, (3) the distribution of birth dates during the summer, (4) the distribution of the time it takes for neonates to become mobile enough to have a picture taken, and (5) the survival function of neonates. We used simulations to evaluate the how many of the processes (1-5, above) can be treated as unknowns while still providing unbiased and precise estimates of the neonate survival function. We found that camera data can provide reliable estimates provided there is prior information on some of the processes (i.e., parturition rates, adult survival, and temporal distribution of birth dates). Based on the results of our simulations, we applied this approach to elk in northern Idaho based on camera data collected during the summer of 2019. Neonate survival was estimated to be ~70% from birth through ~4 months of age and most mortality occurred during the first couple of weeks after birth. Our results suggest great promise in using camera traps to monitor neonate survival across large spatio-temporal extents at much reduced cost when compared to traditional methods.

HURLEY, MARK[1], J. St. Peter[2], M. Hebblewhite[2], S. Bergen[1], E. Roche[1], and B. Oates[1]. [1]Idaho Department of Fish and Game, Boise, Idaho 83707; [2]University of Montana, Missoula, Montana 59812. LINKING PLANT PHENOLOGY AND NUTRITION TO MULE DEER VITAL RATES.

Understanding the relationship between the nutritional quality of a landscape and mule deer vital rates is often compromised by the annual variation in plant phenology, especially in dry seasonal habitats. The nutritional quality of a habitat with an identified plant composition will change within and between seasons depending on the phenology of individual plants. Although many research projects use NDVI from MODIS as a surrogate for nutrition, the true nutritional quality related to plant structure is largely unknown. We used digital cameras to provide a consistent view of vegetation phenology at fine spatial and temporal scales and linked phenology data from these cameras to satellite greenness indices derived from 16-day MODIS NDVI. To estimate phenological variation in nutrition, we documented the growth cycle of plants within each MODIS window using plant composition transects and nutritional analyses of plants at varying phenological stages. We initiated vegetation phenology plots within mule deer summer range and measured each between 3 and 5 times per summer to facilitate linking vegetation phenology, NDVI from cameras, and NDVI from MODIS for that area. We mapped detailed forage species within GPS or VHF collared adult female fawn rearing ranges. Five to 12 composition and ground cover plots were completed using 100m point intercept transects in each adult females home range to produce plant composition estimates for each adult female's home range. We used discrete-time known fates modeling to determine winter fawn survival and estimated fawn ratios from aerial surveys conducted in December. We evaluate the relationship between satellite based

NDVI, cameras, and vegetation plots on nutritional quality of maternal home ranges. We then linked the estimate of nutritional quality on summer range to fawn ratios and winter fawn survival to test the influence of summer nutritional quality to population performance.

KEERY, LORINA*[1], M. Hebblewhite[2], K. Heuer[3], E. Merrill[4]. [1]University of Idaho, Moscow, Idaho; [2]University of Montana, Missoula, Montana; [3]Parks Canada, Banff National Park, Canada; [4]University of Alberta, Edmonton, Alberta, Canada. EVALUATING THE POTENTIAL IMPACTS OF REINTRODUCED PLAINS BISON CONTAINED IN A SOFT-RELEASE PASTURE IN BANFF NATIONAL PARK.

Plains bison (Bison bison bison) have been absent from Banff National Park (BNP) since before its establishment, primarily due to over-hunting in the 19th century. Reintroducing bison to BNP is an important step to restore the full diversity of species and natural processes in the Park's ecosystem. The reintroduction of a dominant ungulate is expected to have a significant impact on the ecosystem through grazing and physical disturbance. My research assessed what impact reintroduced bison had in an 18 ha soft-release pasture system. I monitored the impact bison had on vegetation using a before-after control impact (BACI) experimental design. I also examined a) habitat selection b) diet and c) forage selection of bison. Data were collected in 2016 and 2017, before and after the bison were reintroduced. My results showed bison selected burned forest (Manly's selection ratio, $\beta = 2.1$) and grassland ($\beta = 1.6$) landcover types. Bison strongly avoided the Panther river ($\beta = 0.1$), shrubland ($\beta = 0.4$) and gravel riparian ($\beta = 0.4$, CI = 0.3-0.6) and to a less extent the winter pasture ($\beta = 0.7$) and vegetated riparian ($\beta = 0.8$, CI = 0.7-0.9). Grass dominated bison diet in the summer (92%) which corresponded with strong selection for this vegetation type ($\beta=1.9$). Forbs and shrubs represented minor components of their diet (<1% & 7% respectively) and consequently were avoided (forb, $\beta=0.03$; shrub, ($\beta=0.2$). Multivariate analysis of variance (MANOVA) on forage classes and herbaceous species confirmed that bison had strong impacts on vegetation through herbivory and physical impacts (forage class, $F_{1, 54} = 0.1$, $p=0.04$; herbaceous species $F_{1, 54} = 2.7$, $p=0.01$). My results support Parks Canada's ecological motivations for bison restoration, however ongoing monitoring of ecosystem effects is essential for determining if bison in BNP reach ecologically effective densities and fulfill their ecological function.

KRISTOF, ANDREA[1], B. Wehausen[1], S. Rockwell[2], J. Stephens[2], J. Alexander[2], and J. Barnett[3]. [1]Camas National Wildlife Refuge, Hamer, Idaho 83425; [2]Klamath Bird Observatory, Ashland, Oregon 97520; [3]U.S. Fish and Wildlife Service, Inventory and Monitoring Program, Burbank, Washington 99323. A TALE OF THREE UNDERSTORIES: UPLAND AVIAN COMMUNITIES DIFFER BY DEGREE OF CRESTED WHEATGRASS INVASION OF SAGE-STEPPE HABITAT.

Sagebrush ecosystems, while covering millions of acres in the western United States, are among the most imperiled, challenged by fundamental alterations to ecosystem function, including invasion with non-native grasses. Whereas some non-native grasses have been aggressively combated, crested wheatgrass is subject to more conflicted attitudes. It now occupies >26,000 square miles in the West and debate still wages over its relative invasiveness. Aside from its

poorly documented expansion rate, the influence of Crested Wheatgrass on wildlife is not well understood. We sought to compare the upland avian communities associated with varying degrees of crested wheatgrass invasion at Camas National Wildlife Refuge in east Idaho in order to determine if and how restoration of Crested wheatgrass monocultures might impact native landbirds. Between May and July of 2014-2016, we conducted point-counts across 36 sites equally distributed among the following three habitat types: crested wheatgrass monoculture, sagebrush with crested wheatgrass understory, and sagebrush with native understory. We compared baseline avian species richness, community composition, and individual species abundance among these habitats, and then used HABPOPS, a conservation planning tool, to predict how the avian community would respond to restoration. We found that restoration of crested wheatgrass monocultures back to sagebrush will improve habitat value for wildlife whether or not the understory can be converted to primarily native grasses, or a mix of natives and non-natives. Out of the sagebrush bird species of concern, Brewer's Sparrow occupied both shrub habitat types at similar abundances, and this species could serve as a metric of intermediate restoration success. However, Sagebrush Sparrow and Sage Thrasher, which were significant indicators of sagebrush with native grass, will likely benefit most from restoration of a native herbaceous understory.

KROHNER, JESSICA*[1], J. Millspaugh[1], P. Lukacs[1], J. Sauder[2], B. Inman[3], J. Gude[3], and C. Mosby[2]. [1]University of Montana, Missoula, Montana, 59812; [2]Idaho Department of Fish and Game, Boise, Idaho, 83712; [3]Montana Fish, Wildlife & Parks, Helena, Montana, 59620.
FINDING FISHERS: DETERMINING DRIVERS OF FISHER DISTRIBUTION IN THE NORTHERN ROCKY MOUNTAINS.

The Northern Rocky Mountain (NRM) fisher population (Pekania pennanti) is of special concern to conservation and management professionals and has been petitioned for listing as threatened under the Endangered Species Act. In partnership with Montana Fish, Wildlife & Parks and the Idaho Department of Fish and Game, we assessed the current distribution of fishers across their Northern Rocky Mountain range through a large-scale, multi-state baited camera and hair snare study. Ours is the first range-wide monitoring study of fishers in the northern Rockies. In the winter of 2018/19 we deployed baited remote cameras and hair snare stations in randomly selected grid cells containing predicted fisher habitat throughout Washington, Idaho and Montana, spanning the purported geographic range of the NRM fisher population. We used single-species, single-season occupancy modelling while considering existing fisher habitat models, site-level habitat characteristics, distance from population centers, the influence of past translocation sites and the effect of harvest to estimate occupancy and detection probabilities of fishers across their NRM range. By incorporating our understanding of fisher habitat with contemporary analytical techniques, we estimated the current distribution of fishers in the northern Rockies and addressed the primary uncertainties about drivers of fisher distribution. The results of our project will help the states of Idaho and Montana effectively prioritize areas for future fisher conservation in the hopes of maintaining the distribution of fishers across all suitable habitat in the Northern Rocky Mountains.

LUCID, MICHAEL[1], L. Robinson[1], L. Svancara[1], S. Gillespie[2], D. Paetkau[2], D. Hausleitner[3], A. Kortello[3], G. Mowat[4], S. Ehlers[5], A. Rankin[6], and J. Sullivan[6]. [1]Idaho Department of Fish and Game, Coeur d' Alene, Idaho 83815; [2]Wildlife Genetics International, Nelson, British Columbia; [3]Seepanee Ecological Consulting, Nelson, British Columbia; [4]British Columbia Ministry of the Environment, Nelson, British Columbia; [5]Kootenai Tribe of Idaho, Bonners Ferry, Idaho 83805; [6]University of Idaho, Moscow, Idaho 83843. CARNIVORE CONTACT: A SPECIES FRACTURE ZONE DELINEATED AMONGST HIGHLY GENETICALLY STRUCTURED NORTH AMERICAN MARTEN POPULATIONS (*MARTES AMERICANA* and *MARTES CAURINA*).

North American martens (*Martes americana* and *Martes caurina*) are forest dependent and climate vulnerable. Geographic boundaries of precisely where these two species occur remain unclear. From 2010-2016 we deployed 734 multi-taxa winter bait stations across a 53,474 km^2 study area within a proposed hybrid zone. We collected marten hair samples and developed 17 locus microsatellite genotypes for 235 individuals and 493 base pair sequences of the mtDNA gene COI for 175 of those individuals. We detected a sharp break in genetic structure at the Clark Fork Valley with *M. americana* occurring north of and *M. caurina* south of this valley. We calculated effective population size (N_e), clinal genetic neighborhood sizes (*NS*), observed (H_o) and expected (H_e) heterozygosity, allelic richness (*Ar*), fixation index (F_{ST}) and inbreeding coefficient (F_{IS}). We detected hybridization along the fracture zone with both contemporary and historic gene flow. Marten populations in our study area are highly structured with *M. americana* F_{ST} values (range 0.03-0.12, mean = 0.06) substantially higher than previous continental scale work. With the exception of the Coeur d'Alene Mountains, both species are well distributed at higher elevations within their ranges but with clinal local *NS* sizes. Effective population size estimates suggest modest population sizes for both *M. caurina* [*Ne* = 92 (56 – 208)] and *M. americana* [*Ne* = 254 (159 – 520)]. Elevationaly dependent gene flow along with high genetic structure support that both *M. americana* and *M.* caurina appear to be elevationaly defined by matrix of habitat and non-habitat analogous to 'sky island' type populations of other species.

MACIAS, CAMERON *[1], K. Sager-Fradkin[2], J. Adams[1], and L. Waits[1]. [1]University of Idaho, Moscow, Idaho 83844; [2]Lower Elwha Klallam Tribe Natural Resources, Port Angeles, Washington 98363. COUGAR AND BOBCAT ABUNDANCE, MOVEMENT AND OCCUPANCY 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 abundance, genetic diversity, movement and dispersal patterns and occupancy of cougar (*Puma concolor*) and bobcat (*Lynx rufus*) populations on the north Olympic Peninsula of Washington State from 2018-2019. First, we used specialized scat-detection dogs to locate and collect cougar and bobcat scat samples across our 606 km^2 study area. Of the 207 scat samples collected during the 2018 survey, we had an 89% success rate for genetic species identification (159 bobcat and 20 cougar samples) and identified a minimum count of 55 individual bobcats. Genetic identification analyses are ongoing for the 2018 cougar samples and

162 scat samples collected during the 2019 survey. Second, we equipped 8 adult (4 male and 4 female) and 4 sub-adult (2 male and 2 female) cougars with GPS radio collars from 2018-2019 to observe movement and dispersal patterns. Third, we deployed a 64-camera grid survey in 2018 to estimate occupancy. Cougars were detected in 50% of cells and 28% of cameras, and bobcats were detected in 59% of cells and 39% of cameras. Cameras also reliably detected other carnivores, as well as prey species such as deer (*Odocoileus hemionus columbianus*) and elk (*Cervus canadensis roosevelti*). We will continue these three survey methods through 2020. This research provides baseline data on cougar and bobcat populations in the Tribe's historic use area and will help us to develop non-invasive and cost-effective methodologies for long-term monitoring and management.

MATHEWS, STEVEN*, P. Coates, S. Espinosa, and D. Delehanty. Idaho State University, Pocatello, Idaho 83209. USE OF INTEGRATED POPULATION MODELS (IPMs) IMPROVES POPULATION ESTIMATES IN A SPECIES REINTRODUCTION PROJECT.

Abstract: Historically, restoration of North American lekking grouse (*Tympanuchus & Centrocercus spp.*) via translocation has yielded poor results because translocated individuals exhibit demographic rates that are typically lower than residents in their source populations. For species such as Columbian sharp-tailed grouse (*T. phasianellus columbianus*; CSTG), that occupy ≤ 10% of their historic range, translocation is an important management tool used to help restore, augment, or reintroduce populations. We reintroduced CSTG to northern Nevada, USA from wild stock populations in Idaho, USA, during 2013 – 2017 and used an integrated population models (IPM) to model population dynamics. Implemented within a Bayesian framework, IPMs allow for the inclusion of disparate data and prior information within a single modeling environment to produce more accurate parameter estimates than traditional Leslie-matrix or cohort life table analyses. In our study, this constituted the integration of observed lek-counts and demographic data derived from telemetered individuals. Our model initially predicted population extirpation within five years of translocation, but model-predictions were misaligned with observed lek counts. We then utilized informative priors to estimate demographic contributions of non-monitored cohorts of native CSTG known to be present, and the model accurately predicted observed lek counts and population growth. The informative-IPM revealed an important demographic process that drives establishment of lekking grouse during reintroduction efforts, whereby non-monitored native individuals have demographic rates similar to source populations and recent translocated individuals did not. In our project, the offspring of translocated grouse were the high-quality individuals that contributed the most to population restoration. Without accounting for demographic differences among cohorts, wildlife managers could infer misleading long-term population projections. By accounting for non-monitored cohorts in an IPM framework, wildlife managers can more accurately evaluate current and future reintroductions and design techniques that facilitate immediate reproduction at release sites. Findings are preliminary and provided for timely best science.

MILLER, PAIGE*, D. Bush, and D. Delehanty. Idaho State University, Pocatello, Idaho 83209.
THERMAL ECOLOGY OF TRUMPETER SWAN (*CYGNUS BUCCINATOR*) INCUBATION.

Trumpeter Swans (Cygnus buccinator) residing year-round in the Greater Yellowstone Ecosystem of Idaho, Montana, and Wyoming comprise a subpopulation of significant management focus. Swans are conspicuous birds that nest openly on large vegetative mounds. Previous observations have correlated swan incubation recess occurrence with time of day. Swans exhibit constant nocturnal incubation and take mid-morning and mid-afternoon diurnal incubation recesses. We are investigating the timing of swan recesses in relation to the prevailing thermal conditions in the nest environment. We are also measuring the thermal effects of the nest structure. We hypothesize that the nest structure augments swan incubation behavior by providing thermal inertia, and also may generate heat through decomposition of nest vegetation. For conservation, it would be valuable to understand how swans breeding at high elevations in a cold environment can be successful, especially in light of management proposals to use artificial floating nest platforms which may not function like natural nests. In 2019, we used continuous videography to measure swan incubation behavior at Bear Lake and Grays Lake National Wildlife Refuges. After swan cygnets hatched and left nests with adults, we installed Thermochron iButton® temperature loggers within empty swan eggshells and placed two eggs in each of two nests at Grays Lake National Wildlife Refuge, one in the center of the nest cup and one buried 10 – 12 centimeters in the nest material. This simulated recesses in which eggs were left uncovered and covered by adults, respectively. Uncovered eggs underwent more variable temperature fluctuations (range 3.7 – 50.3 °C) than covered eggs (range 16.6 – 28.8 °C). We attribute this variation primarily to differences in radiative heat gain diurnally, and conductive, convective, and radiative heat loss nocturnally. We seek to investigate swan incubation behavior and thermodynamics further in 2020.

MOSBY, CORY[1], T. Gregory[1], C. Pozzanghera[1], J. Utz[1], C. Yarbrough[1], J. White[2], and D. Mynear[3]. [1]Idaho Department of Fish & Game, Boise, Idaho, 83712; [2]U.S. Fish and Wildlife Service, Boise, Idaho 83709; [3]Idaho Soil and Water Conservation Commission, Boise, Idaho 83702. STATEWIDE SUMMARY OF RIPARIAN IMPROVEMENT PROJECTS UTILIZING PROCESS BASED RESTORATION TECHNIQUES.

Over the last several years, low-tech, process-based riparian restoration has been occurring throughout Idaho. The implementation of beaver dam analogs (BDAs), Post Assisted Log structures (PALs), woody debris jams and other various structures, as well as the translocation of beavers have all been utilized to accomplish a wide variety of restoration objectives. We discuss a number of recent projects that have occurred on private, State and Federal land throughout the state. These projects have diverse goals ranging from hastening post-fire riparian recovery in sage-grouse habitat, to improving stream conditions for anadromous fish, to facilitating the establishment and expansion of beaver populations.

MEYERPETER, MARY*[1,2], P. Coates[2], B. Prochazka[2], S. Mathews[1,2], and D. Delehanty[1]. [1]Idaho State University, Pocatello, Idaho, 83209; [2]U.S. Geological Survey, Western Ecological Research Center, Dixon, California 95620. EFFECT OF TRANSLOCATION ON REVERSING POPULATION DECLINE OF AN IMPERILED SUBPOPULATION OF GREATER SAGE-GROUSE.

Greater sage-grouse (*Centrocercus urophasianus*) have experienced substantial and ongoing range contraction over the past century. Translocation, the deliberate transfer of animals from one location to another, can be used to reinforce small, declining populations thereby reducing local extirpation and subsequent range contraction. In this study we translocated sage-grouse from a donor population to reinforce a small, declining subpopulation of sage-grouse within a distinct population segment (DPS) located in eastern California. We translocated males, pre-nesting females and females with broods (a novel method). Using a Before-After-Control-Impact study design, we evaluated the degree to which translocation increased lambda (λ), the finite rate of change of the imperiled subpopulation as well as its 10-year extirpation probability. Population estimates and projections were derived from an integrated population model. For controls, we used a long-term dataset consisting of lek counts and demographic data across multiple regional subpopulations within the DPS. Preliminary results demonstrate that 2 years of translocation reversed population declines and substantially reduced near-term extirpation probability for this imperiled subpopulation of sage-grouse. Translocation, and particularly brood translocation, may be an effective way to rescue small sage-grouse populations.

NADEAU, STEVE. Boise, Idaho 83709. THE JOURNEY OF THE BITTERROOT GRIZZLY BEAR.

Bitterroot grizzly bear (*Ursus arctos*) recovery efforts began in 1987 and involved an innovative approach to endangered species recovery. Drawing from his new book, *Journey of the Bitterroot Grizzly,* Nadeau will describe the inside look at this recovery effort and describe the story of a remarkable grizzly that was born in the Selkirk mountains in 2002 and travelled 200 miles to the Bitterroots by 2007 – the first to do so in 60 years. Nadeau will also discuss the recent movements of grizzly bears in an around the Bitterroot recovery area and how these grizzly bears have survived the gauntlet to try to establish a new population in central Idaho.

NERKOWSKI, STACEY*[1], P. Hohenlohe[1], K.Warheit[2], and L. Waits[1]. [1]University of Idaho, Moscow, Idaho 83844; [2]Washington Department of Fish and Wildlife, Olympia, Washington 98501. GENOMIC ASSESSMENT OF PYGMY RABBIT POPULATIONS INCLUDING THE ENDANGERED COLUMBIA BASIN PYGMY RABBIT (*BRACHYLAGUS IDAHOENSIS*).

Pygmy rabbits (*Brachylagus idahoensis*) are the smallest rabbit in North America and are unique among rabbits due to their ability to consume sagebrush. Loss and fragmentation of habitat has led to the near extirpation of the disjunct pygmy rabbit population in the Columbia Basin (CB) of Washington (WA) State. In 2003, the CB pygmy rabbit (CBPYRA) was listed as an endangered distinct population segment under the US Endangered Species Act. In 2001, sixteen CBPYRA were taken from the last remaining population in WA to start a captive breeding program, and four

Idaho rabbits were added to counteract the effects of inbreeding. Rabbits were moved to semi-wild breeding enclosures in 2011, and additional rabbits were translocated from other populations within the western United States (Nevada, Oregon, Utah and Wyoming). Since then ~1947 mixed ancestry rabbits have been released into the wild. To provide insight into genomic diversity and ancestry of the mixed CBPYRA populations we must first understand the regional source populations that contribute to these mixed ancestry rabbits. We used restriction site-associated DNA sequencing (RADseq) on 220 rabbit samples from all source populations, as well as additional samples from Idaho, Montana, Nevada, and California, to generate the first genome-wide set of single nucleotide polymorphism (SNP) markers for this species. PCA and STRUCTURE analyses have identified four genetic clusters: CB, Great Basin (including Nevada/Oregon/Idaho/Montana/California), Wyoming/northern Utah and southern Utah. We identified adaptive loci and private alleles in each of the populations. A fine scale analysis of the genetic structure within Idaho has shown the Snake River to act as a possible barrier to gene flow. We have designed a SNP marker panel to assess ancestry in the CB populations and to genetically monitor captive and wild populations of CBPYRA to guide strategies for conservation and management.

OLSOY, PETER*[1], C. Milling[2], J. Nobler[3], M. Camp[1], L. Shipley[1], J. Forbey[3], J. Rachlow[4], and D. Thornton[1]. [1]Washington State University, Pullman, Washington 99164; [2]Ohio State University, Columbus, Ohio 43210; [3]Boise State University, Boise, Idaho 83725; [4]University of Idaho, Moscow, Idaho 83844. MULTI-SCALE HABITAT SELECTION OF PYGMY RABBITS (*BRACHYLAGUS IDAHOENSIS*) REVEALS DIFFERENTIAL SELECTION OF FOOD AND SECURITY.

The concept of scale is essential in understanding what drives patterns in ecology. Patterns that emerge at one scale can be the opposite of those that occur at another nested scale, and the mechanisms that drive those patterns may also change across scales. At each scale, herbivores must balance the competing risks of starvation, predation, and thermal stress. Frequently, herbivores must choose between abundant, high-quality forage and high predation risk or poor forage and low predation risk. In this study, our objective was to examine how a small dietary and habitat specialist, the pygmy rabbit (Brachylagus idahoensis), responds to food, security, and thermal properties at two different spatial scales. We found that pygmy rabbits select for food variables (i.e., crude protein and total monoterpenes) while foraging (bite marks) at the plant scale, and selected for both security cover (i.e., aerial concealment and distance to burrow) and food variables at the patch scale. While moving and resting (fecal pellets), pygmy rabbits selected for a combination of food, security, and thermal properties, with thermal variables appearing more frequently in top models at the plant scale, and primarily for security at the patch scale. Finally, we applied our patch-scale model of pygmy rabbit habitat selection across the landscape using UAS (unmanned aerial system)-derived maps of security cover and food quality. These results show scale-dependent habitat selection in a central-place browsing herbivore. Making explicit predictions of trade-offs affecting habitat use, and assessing those predictions at distinct scales, will be necessary for improving knowledge of habitat selection patterns in herbivores.

PAPROCKI, NEIL*[1]. C. Conway[1,2], and J. Kidd[3]. [1]University of Idaho, Moscow, Idaho 83843; [2]U.S. Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit, Moscow, Idaho 83843; [3]Kidd Biological, Inc., Anacortes, Washington, 98221. IDAHO'S IMPORTANCE TO MIGRATING AND WINTERING ROUGH-LEGGED HAWKS BASED ON GPS TRACKING DATA.

The Rough-legged Hawk (*Buteo lagopus*) breeds throughout arctic and subarctic regions of North America and winters throughout the coterminous United States, with no spatial overlap between breeding and wintering areas. From 2014 – 2019, we deployed satellite and GPS transmitters on Rough-legged Hawks to document their migration behavior. We trapped and deployed transmitters on hawks on the wintering grounds, the breeding grounds, and during migration. Most transmitters were deployed on hawks that wintered in western North America, however none were deployed in Idaho prior to 2019. Despite this, 69% (n=47 of 68) of hawks migrated through Idaho, took migratory stopovers in Idaho, or spent portions of their winter in Idaho. Furthermore, hawks that wintered west of the Rocky Mountain front range were even more likely to migrate through, stopover, or winter in Idaho (81% or n=47 of 58). Christmas Bird Count data indicates that Idaho, and particularly the Snake River plain, supports some of the highest counts of wintering Rough-legged Hawks in North America. However, our results also highlight the importance of Idaho as a major migratory corridor and stopover region for hawks wintering in Washington, Oregon, California, Nevada, and Utah. As Rough-legged Hawk winter ranges continue to shift northwards (Paprocki et al. 2014), it is possible that Idaho may become an increasingly likely winter destination for hawks that historically wintered at more southern latitudes. This research highlights the population-level importance of Idaho for both wintering and migrant Rough-legged Hawks in western North America.

PETERSON, CHARLES, and P. Giltz. Idaho State University, Pocatello, Idaho 83209. USING CROWDSOURCED DATA FOR EVALUATING SPECIES STATUS AND TRENDS.

Although crowdsourced / citizen science observations have become an important source of biodiversity information, applying the data to evaluate species status and trends is problematic. Because these data have no underlying sampling design and only document presence, the major problem is distinguishing absence from a lack of observation effort. Our approach begins by plotting the coordinates for observations of a species on the EPA EMAP 635 km^2 hexagon grid for which there are 404 hexagons covering Idaho. A hexagon is considered occupied if at least 1 observation of the species occurs within it. A hexagon without any observations of the species of interest but with observations for similar species is considered unoccupied. A hexagon for which there are no observations of the species of interest or for similar species is considered unsampled. This procedure results in a coarse map indicating where the species occurs, where similar species have been observed but the species of interest was not detected, and where we have no crowdsourced data. The current status of the species is scored as the percent of hexagons occupied. To determine trends, we compare the current map with a map of historical occupancy based on known records for a previous time interval. This comparison results in a hexagon map containing 5 categories: persisting, increasing, declining, unoccupied, unknown. We applied this approach to the Northern Leopard Frog, an Idaho Species of Greatest Conservation Need. We used data from the Idaho Species Diversity Database to determine historic occupancy (up to

2015) and observations from the Idaho Amphibian and Reptile iNaturalist Project (2016-2019) with the following results: 4% persisting, 2% expanding, 14% declining, 43% unoccupied, and 37% unknown. These data suggest a decline of about 65% in historic occupancy. This approach should be useful when preparing the next Idaho State Wildlife Action Plan.

RACHLOW, JANET[1], R.M. Stein[1], J.U.H. Eitel[1], and B. Lecigne[2]. [1]University of Idaho, Moscow, Idaho 83844; [2]Université du Québec à Montréal, Montreal, Canada. VIEWSHED ANALYSES: INCLUDING VISIBILITY AS A PROPERTY OF WILDLIFE HABITAT.

For many wildlife species, visual assessment of their surrounding environment influences selection of sites for nesting, mating, and foraging. Prey species often use their habitat to increase survival by concealing their presence, but also might increase probability of survival by detecting predators and taking evasive actions. Likewise, predators that detect prey can evaluate costs and benefits of pursuit. Indeed, a growing recognition of the influence of spatially explicit visual information on ecological processes has led to a call for development of an integrated approach for studying 'viewshed ecology' (Aben et al. 2018). We have developed methods and tools (viewshed3d R package, Lecigne and Eitel 2020) to quantify properties of viewsheds (visual detection and the potential for concealment) using terrestrial laser scanning (TLS) technology that produces high-resolution 3D models of an environment. We will demonstrate how this technology functions and provide examples of applications to assessment of wildlife habitat for diverse species and ecological questions. Integrating animal perception into assessment of habitat resources will not only increase our ability to understand how wildlife select habitats and respond to changes, but also enhance opportunities for habitat management and restoration based on functional links between habitat and animal populations.

REGAN, TEMPE[1], and L. Svancara[2]. [1]Idaho Department of Fish and Game, Salmon, Idaho 83467; [2]Idaho Department of Fish and Game, Moscow, Idaho, 83843. THE SEARCH FOR IDAHO'S HIDDEN GEMS: ALPINE SPECIES OF GREATEST CONSERVATION NEED.

Idaho Fish and Game's Salmon Region is home to the greatest proportion of alpine habitat in the state of Idaho. A number of Idaho's Species of Greatest Conservation (SGCN) need are obligate alpine inhabitants. However, very little is known of their basic biology and life history because of the difficulty in accessing, and safely surveying, rugged alpine terrain. In the summer of 2019, we initiated a pilot study targeting Black Rosy-finches (Leucosticte atrata), Hoary Marmots (Marmota caligata), American Pika (Ochotona princeps), Mountain Goats (Oreamnos americanus), Bighorn Sheep (Ovis Canadensis), amphibians and a number of invertebrates including Alpine Tiger Beetle (Cicindela plutonica), bumblebees, the Beartooth Copper (Lycaena phlaeas), and spur-throated grasshoppers in the Salmon Region. We designated alpine habitat and drew a spatially-balanced random sample of 50 4x4 km grid cells that contained at ≥ 25% alpine habitat. Within these grids we selected N/NE facing basins, if possible, as potential survey sites. We used a distance sampling protocol for Black Rosy-finches, American Pika, Hoary Marmots, Bighorn Sheep and Mountain Goats and opportunistically surveyed invertebrates. When alpine lakes occurred within our survey areas, we conducted visual encounter surveys for amphibians. We backpacked into survey grids between July 4 and August

28; accomplishing 25 surveys in 7 different mountain ranges. We hiked 216 km, and horse-packed 77 km, to access surveys. While on formal surveys we hiked a total of 77 km. Our detections included a total of 128 Black Rosy-finches and 265 American Pika. The only species we did not detect on our surveys were the Beartooth Copper and Alpine Tiger Beetle. We are currently analyzing data and refining the protocol with plans to continue alpine surveys in the Salmon Region and expand into the other regions that contain alpine habitat.

RETHERFORD, DREW*[1], R. Larsen[1], S. Roberts[2], D. Englestead[3], S. Norman[3], D. Price[3], C. Colt[4], and J. Whiting[5]. [1]Brigham Young University, Provo, Utah 84602; [2]Idaho Department of Fish and Game, Idaho Falls, Idaho 83401; [3]Bureau of Land Management, Idaho Falls, Idaho 83401; [4]U.S. Forest Service, Pocatello, Idaho 83204; [5]Brigham Young University Idaho, Rexburg, Idaho 83460. FIDELITY AND MOVEMENTS OF FEMALE GREATER SAGE-GROUSE (*CENTROCERCUS UROPHASIANUS*) DURING BREEDING SEASON.

Greater sage-grouse (*Centrocercus urophasianus*, hereafter sage-grouse) are a species of conservation concern. Each spring female sage grouse attend leks, or communal breeding grounds, where males display to compete for breeding opportunities. Little is known about the size of breeding areas used by females, as well as, their fidelity to breeding areas or specific leks. During spring of 2015-2018, we attached GPS transmitters to 234 female sage-grouse in eastern Idaho. We quantified breeding area size, how many leks females visited while breeding, and fidelity to breeding areas and specific leks across years, as well as, abiotic factors that influenced breeding area size. To calculate the size of breeding areas, we generated 95% Brownian bridge estimates for each bird in each year. To quantify fidelity, we overlaid 95% Brownian bridge estimates for each bird with consecutive attempts and calculated the percentage of overlap. We used AIC model ranking to determine which variables affected the size of Brownian bridge estimates. The mean size of breeding areas was 51 km^2 (n = 68, SD = 74.6, range = 1.0 to 400.9). Each bird visited a mean of 2 leks (n = 68, SD = 1.2, range = 1 to 5). We quantified 18 breeding attempts by the same female in consecutive years, and the mean overlap in breeding areas was 41% (SD = 32, range = 5.6% to 100%). Of those 18 females, only 7 individuals visited the same lek in consecutive years and none had more than one common lek in consecutive years. Study area was the only variable supported in all three top models; however, the number of leks visited and breeding year appeared in two of our top three models. Our results have important management implications for state and federal agencies who manage sage grouse and their habitat

ROGERS, SAVANNAH*[1], C. Robbins[2], P. Mathewson[3], A. Carnahan[2], F. van Manen[4], M. Haroldson[4], W. Porter[3], T. Rogers[1], T. Soule[1], and R. Long[1]. [1]University of Idaho, Moscow, Idaho 83844; [2]Washington State University, Pullman, Washington 99163; [3]University of Wisconsin, Madison, Wisconsin 53706; [4]Interagency Grizzly Bear Study Team, U.S. Geological Survey. CLIMATIC CONSTRAINTS ON ENERGY BALANCE, BEHAVIOR AND SPATIAL DISTRIBUTION OF GRIZZLY BEARS.

Global climate is warming at an unprecedented rate, and the potential for climate change to influence behavior or performance of mammal populations by increasing costs of

thermoregulation and activity has received relatively little attention. Large mammals like grizzly bears (Ursus arctos) in particular are subject to greater limitations because of their relatively small surface-area-to-volume ratio and thicker boundary layer. Our goal was to quantify the relative importance of regulatory behaviors for maintaining heat balance in lactating and non-lactating female bears and to understand the impact of these constraints on the spatio-temporal distribution of bears in the Greater Yellowstone Ecosystem Grizzly Bear Recovery Zone (GYE). We used the mechanistic modeling software Niche Mapper to predict energetic costs incurred by female bears in summer under current (measured) climatic conditions and under conditions predicted by the IPCC (i.e., 2.5o-C increase in mean temperature). To explore this effect in a current population we used a genetic program to evaluate the relative influence of costs imposed by the thermal environment on the spatial distribution and activity level of female grizzly bears in the GYE. Simulated results suggested that bears are already forced to invoke behavioral cooling mechanisms, and that lactating females experienced a relatively greater benefit from behavioral mechanisms than non-lactating females. This trend will become more pronounced as the climate warms. In the GYE population, human disturbance remains the most important factor in predicting grizzly bear distributions, although variation in the thermal environment did have a greater influence on the distribution of lactating than non-lactating female bears. Lactating females are therefore subject to greater climatic constraints on the timing and intensity of activity than their non-lactating counterparts, and this constraint has a greater influence on their distribution at the landscape level. This result is consistent with predictions of the Heat Dissipation Limit Theory and has important implications for the distribution and performance of grizzly bear populations in the GYE as the earth's climate continues to warm.

SCOTT, J. MICHAEL[1], J. Wiens[2], B. Van Horne[3], and D. Goble[4]. [1]University of Idaho and U.S. Geological Survey (retired); [2]Colorado State University (retired); [3]U.S. Forest Service (retired); [4]University of Idaho (retired). THE CHALLENGES OF MANAGING CONSERVATION-RELIANT SPECIES.

There are some 1,000 imperiled species in the United States and nearly 25,000 globally that are *conservation reliant*. They face threats that cannot be eliminated but only managed, and the management may be needed for a very long time. As climate change pushes more species toward extinction, the queue of conservation-reliant species will continue to grow. This reality poses a fundamental challenge to conservation, both locally and globally. Resources for conserving imperiled species are already inadequate; the long-term demands of conservation-reliant species will further strain conservation resources and societal support. We won't be able to do it all. Investments in conservation will need to be prioritized, acknowledging the long-term costs of conservation reliance while incorporating the social and cultural context as well as science. To address this challenge, conservation, management, and the societal commitment to conservation will need to change. In this presentation we will identify the challenges and opportunities for application of lessons learned in past conservation activities globally. We will emphasize the ecological, cultural, social, economic, and legal challenges faced in dealing with conservation reliance, as well as lessons learned from management successes and failures. We will conclude with a discussion of ways forward.

SHAHVERDIAN, SCOTT[1], and J. White[2]. [1]Anabranch Solutions, Newton, Utah 84327; [2]U.S. Fish and Wildlife Service, Boise, Idaho 83714. A NOVEL STREAM RESTORATION MONITORING APPROACH IN A POST-FIRE SETTING.

We developed and implemented a novel monitoring approach to assess the restoration effectiveness of low-tech process-based restoration in a post-fire context in the lower Baugh Creek watershed, site of the 2018 Sharps Fire. We collected data using remote sensing and field surveys to understand the response to restoration at multiple spatial scales and understand the mechanisms responsible for changes following restoration. Preliminary results highlight: 1) the need to understand recovery trajectories and associated time-frames associated with variable starting conditions, 2) the challenges associated with monitoring larger scale restoration projects, 3) the importance of using methods capable of being implemented by a diverse set of practitioners, and 4) how monitoring must be sustained beyond the short term in order to effectively guide adaptive management. After one year, we found that the majority of restoration structures are intact and forced local geomorphic changes, however remote sensing data was less likely to observe geomorphic change, due to the limited scale of change and the limited high flows since restoration. We observed considerable differences to restoration structures between the three different treatment streams. At the scale of the entire project we observed increased sediment retention in the form of uniform channel aggradation and the development of bars, while at the scale of individual structures, geomorphic responses also included scour of the channel bed and bank erosion. Our monitoring illustrates how large-scale restoration projects can leverage large study areas, and numbers of structures to open the doors to new approaches to restoration effectiveness monitoring that incorporates data collected at multiple spatial scales.

SHIPLEY, L.A.[1], M. Camp[1], and J. Varner[2]. Washington State University[1], Pullman, Washington 99164; Colorado Mesa University[2], Grand Junction, Colorado 81501. ACTIVITY PATTERNS AND FORAGING BEHAVIOR OF AMERICAN PIKAS (*OCHOTONA PRINCEPS*) DIFFERS BETWEEN CRATERS OF THE MOON AND ALPINE TALUS IN IDAHO.

Range contractions in the Great Basin over the last century suggest American pikas might be highly sensitive to climate change. However, documentation of pikas residing at relatively warmer, low-elevation sites has recently shed new light on the possible resilience of pika populations to warmer ambient conditions when they have access to cooler microhabitats for thermoregulation. To provide insight into possible behavioral mechanisms of adaptation to warmer habitats, we investigated activity patterns, foraging behavior, and space use of a population of pikas living in an atypical, warmer habitat at Craters of the Moon National Monument and Preserve, an extensive lava flow surrounded by high desert grassland and sagebrush communities in southern Idaho. We compared their behavior to that of a population in a typical alpine habitat at Grays Peak in the nearby Pioneer Mountains in Idaho. Pikas were the least active midday when the surface temperatures were highest, and the insulating effect of the lava tubes was most pronounced. Pikas at Craters of the Moon spent less time haying and displayed fewer territorial behaviors than pikas at Grays but filled a similar number of haypiles. The vegetation community was less diverse and sparser at Craters than at Grays, and consequently, vegetation that was consumed and cached reflected these differences. Our results

expand the body of literature on American pikas at their environmental limits and this study is the first step in identifying the unique suite of behaviors pikas use to persist in a seemingly inhospitable environment at Craters of the Moon.

STACY, ELISE*[1], L. Waits[1], and M. Robards[2]. [1]University of Idaho, Moscow, Idaho 83844; [2]Wildlife Conservation Society, Fairbanks, Alaska 99775. EVALUATING GENETIC STRUCTURE OF WOLVERINES IN ARCTIC AND SUBARCTIC ALASKA: POPULATIONS ON A CHANGING LANDSCAPE.

Despite being an important furbearing species in Alaskan culture, economy, and ecosystems, the broadscale genetic population structure of wolverines (Gulo gulo) in northern Alaska has not been studied. We are investigating whether natural or anthropogenic landscape features act as gene flow restrictors and will compare two genetic marker types, microsatellite and single nucleotide polymorphism (SNP) loci, for their ability to detect population structure. We are testing whether population structure is driven by natural landscape factors such as ecoregion boundaries, if population structure is driven by anthropogenic transportation infrastructure, and if SNPs will provide a greater ability to detect population structure than microsatellites. Natural or anthropogenic landscape features acting as barriers or facilitators of dispersal can have implications for management in the face of land development and climate change. We are obtaining tissue, hide, and hair samples through collaboration with the Wildlife Conservation Society's wolverine capture project, the North Slope Borough Department of Wildlife Management, local wolverine trappers and fur handlers. Preliminary results on samples collected from the first study season (n=83) using 12 microsatellite markers and Bayesian clustering analysis (STRUCTURE) reveals that wolverines in northern Alaska belong to one population. This is supported by maximum likelihood relatedness analysis as well. All loci were found to be in Hardy-Weinberg Equilibrium following Bonferroni correction, with number of alleles ranging from 3 to 8 (mean 5.5) and observed heterozygosity between 0.35 and 0.76 (mean 0.59). Isolation by distance analysis on samples with location information accuracy within 30 kilometers (n=74) revealed no significant relationship between genetic distance and geographic distance. Future analysis includes comparing microsatellite loci to single nucleotide polymorphism (SNP) loci for their ability to detect population structure and patterns of dispersal. Sample collection is ongoing and aims to achieve an even sample distribution across northern Alaska.

STANSBERRY, BRET[1], N. Bilodeau[2], F. Cassirer[3]. [1]Idaho Department of Fish and Game, Salmon, Idaho 83467; [2]University of Idaho, Moscow, Idaho 83844; [3]Idaho Department of Fish and Game, Lewiston, Idaho 83501. BIGHORN SHEEP IN CENTRAL IDAHO: PAST, PRESENT, AND FUTURE.

Bighorn sheep (*Ovis canadensis*) have been an important species to the human inhabitants of Central Idaho for thousands of years. Archaeological and paleontological evidence indicates that indigenous people utilized bighorn sheep beginning at least 10,000 BP, possibly longer. They continued to be an important resource well into the latter 1800's, particularly for a segment of the Shoshoni people known as the "Sheepeaters" or *tukudeka*. Historic accounts of the number of

sheep at the time of European expeditions to the area are general in nature, but when pieced together, reveal that the population was probably in the tens of thousands in the early to mid-1800's. Overharvest and disease reduced the population significantly by 1900. Restrictions on sport harvest was introduced by the 1890's and became progressively restrictive. The population increased modestly throughout the mid-20th century. Present day research seeks to answer questions to low lamb recruitment and poor population performance. That knowledge along with careful harvest and habitat management will hopefully lead to more robust bighorn sheep populations.

STAUDENMAIER, ANNA*, L.A. Shipley, D.H. Thornton, and M.J. Camp. Washington State University, Pullman, Washington 99164. A COMPARISON OF THE FUNDAMENTAL NUTRITIONAL NICHES OF MULE (*ODOCOILEUS HEMIONUS*) AND WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*).

Although similar taxonomically and ecologically, ranges of mule and white-tailed deer are segregated across much of North America, except for a broad north-south zone roughly along the Rocky Mountains. Although free-ranging deer have been extensively studied in areas of both allopatry and sympatry, little is known about differences in their fundamental nutritional niches that might shape this distribution. However, field studies suggest that mule deer might be better able to tolerate plant fiber and plant secondary metabolites than white-tailed deer. Therefore, we directly compared the ability of mule and white-tailed deer to digest fiber and tolerate plant secondary metabolites such as tannins and monoterpenes using in vivo digestion and feeding trials with 5-6 tractable deer of each species. When fed diets of a natural forage (willow leaves), and pelleted diets with both high and low fiber, mule and white-tailed deer digested the protein, energy, and fiber in the diets to the same degree. When fed a diet with the monoterpene α-pinene, intake declined linearly for both species as the percent of α-pinene increased from 0-4% over 11 days and no difference in detoxification rates was found. Our findings suggest that white-tailed deer and mule deer have very similar fundamental nutritional niches which could lead to competition for food resources where sympatric.

SZABO, SHAWN, and C. Mosby. Idaho Department of Fish and Game, Boise, Idaho 83712. NON-TARGET AVOIDANCE; HOW DIVERTERS ON WOLF SNARES AFFECT NON-TARGET CAPTURE RATES OF ELK AND WHITETAILED DEER.

The use of snares to capture wolves and other furbearers are an important tool in the use of regulated trapping in wildlife management. As a lethal device, concerns exist to minimize non-target captures of wolf snaring equipment on ungulates such as elk and deer. One approach to reduce non-target capture of moose in wolf snares is to equip the snare with a diverter, but this approach has not been tested on species more representative of Idaho. During the winters of 2018 and 2019 we placed snares equipped with and without diverters and trail cameras on game trails. We filmed 213 elk interactions and 250 whitetailed deer interactions with snares. Results are pending, but initial review suggests that capture rates are higher with deer than elk, and that diverters may affect capture rates because both elk and whitetailed deer are more likely to notice a snare equipped with diverters than without. Overall, this information will help inform

conversations on the social and biological implications of wolf snaring, and improve our ability to reduce non-target captures.

TOWNSEND, KASSANDRA*[1], C.J. Conway[2], and K.T. Vierling[1]. [1]University of Idaho, Moscow, Idaho 83844; [2]U.S. Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, Idaho 83844. NEST-SITE CHARACTERISTICS OF THE HAWAIIAN COOT (‘ALAE KE’ OKE’O; FULICA ALAI) AT KEALIA POND NATIONAL WILDLIFE REFUGE, MAUI, HAWAII.

The Hawaiian Coot (Fulica alai) was listed in 1970 as endangered under the Endangered Species Act and is endemic to Hawaii. The most recent 5-year review for the species, conducted in 2010, concluded that none of the four criteria for delisting had been met. Maui has the second largest population in the state and Kealia Pond National Wildlife Refuge is one of two strongholds for the coot in Maui. The refuge contains open water, mudflats, and wetland habitats that are important for the coot. Unfortunately, not much is known about the nesting behavior or nest-site selection of the Hawaiian Coot. Such information is important for management agencies who want to manage invasive wetland plants on the island or hope to recover and delist the coot. We tested whether Hawaiian Coot nest-site selection was influenced by introduced and invasive vegetation cover, water depth of the ponds, and the distance to shoreline. In the summer of 2019, we collected data on nest-site characteristics and recorded the plant species that coots used to build their nests. We also recorded the vegetation surrounding coot nests in each cardinal direction at one, three, and five meters from the nest. We also measured water depth at each nest, the height of the nest above ground, and the distance to nearest shoreline. We recorded these measurements for twenty nest sites and compared these data to twenty random points (i.e., non-nests). Random nest sites were chosen using ArcGIS in areas that appeared suitable but did not contain coot nests.

WALKER, RYAN[1], L. Peterson[1], and B. Lazarus[2]. [1]Idaho Department of Fish and Game, Idaho Falls, Idaho 83401; [2]U.S. Geological Survey, Boise, Idaho 83706. EFFECTS OF POST-FIRE BACTERIAL AND CHEMICAL TREATMENT OF INVASIVE ANNUAL GRASSES ON TEX CREEK WILDLIFE MANAGEMENT AREA.

The post-fire restoration and recovery of sagebrush steppe can be heavily compromised by invasive annual grasses, and the ability to take action shortly after a fire event can improve the vegetative response and likelihood of success. Months after the Henry’s Creek fire burned approximately 22,000 acres of sagebrush steppe on Tex Creek Wildlife Management Area in 2016, we applied the MB906 strain of *Pseudomonas fluorescens* alone and in combination with a reduced rate of imazapic (0.053 kg a.i. ha^{-1}) to test the efficacy of a combination of treatments on the response of invasive annual and perennial grasses. We measured vegetation using line-point intercept transects in 24 paired plots to generate percent cover in treated and untreated areas for the first 3 years after application. MB906 did not reduce percent cover of invasive annual grasses in any year. Imazapic reduced percent cover of invasive annual grasses without affecting perennial grasses in the first year. MB906 and imazapic reduced percent cover of invasive

annual grasses in years 1 and 2, but not year 3. Perennial grass cover was affected by any treatment. MB906 does not appear to be an effective treatment for invasive annual grasses and several possible issues will be discussed. This leaves chemical treatment as the only current method to help restore and recover sagebrush steppe following wildfire.

WISHNEK, BEN[1], J. Jirak[1], D. Edmonds[1], and J. Barnett[2]. [1]Bear Lake National Wildlife Refuge, Montpelier, Idaho 83254; [2]U.S. Fish and Wildlife Service, Inventory and Monitoring Branch, Burbank, Washington 99323. TOO MUCH OF A GOOD THING: REDUCING ROBUST EMERGENT VEGETATION FOR WILDLIFE BENEFIT ON THE RAINBOW UNIT OF BEAR LAKE NATIONAL WILDLIFE REFUGE.

Robust emergent vegetation in palustrine wetlands at Bear Lake National Wildlife Refuge (BRL) can have many benefits including, nesting cover, food resources and retention of pollutants. However, the hydrology and natural disturbance regimes of these wetlands have been altered in a manner that has allowed robust emergent plants to thrive and reduce open water which is necessary for certain portions of the life histories of wetland-dependent wildlife. Consequently, interventions to set back succession are necessary due to the altered disturbance regimes. The 582 ha Rainbow unit at BRL was constructed from 1980-81 to better manage water levels and reduce impacts from sedimentation and invasive common carp (*Cyprinus carpio*). Relatively little disturbance had taken place up through 2018 and vegetation surveys in 2014-2015 depicted a unit not meeting habitat goals set forth in the Refuge's Comprehensive Conservation Plan. A series of management actions including drawdown, prescribed fire, herbicides, piscicides, disking and plowing were implemented in 2018 to simulate historic natural disturbance regimes. Some of these tools had been used in the past at BRL; however, use of all tools in concert was unprecedented. Accordingly, vegetation was re-surveyed in 2019 and will be surveyed again three and five years post-intervention to assess efficacy of the management actions. Results from this pre- and post-implementation survey will guide planning of future interventions to match historic disturbance regimes as closely as possible.

YOUNG, AARON*, and T. Johnson. University of Idaho, Moscow, Idaho 83844. REMOVING JUNIPER IN THE SAGEBRUSH ECOSYSTEM: TESTING THE RELATIONSHIP BETWEEN JUNIPER AND AVIAN PREDATORS.

Understanding the implications for altered habitat structure on community composition and species interactions is vital to conservation of multiple populations. Juniper (*Juniperus occidentalis*) expansion in the sagebrush ecosystem is one factor associated with declines of greater sage-grouse (*Centrocercus urophasianus*) populations. However, effects of juniper expansion on other groups associated with sagebrush and juniper-woodland ecosystems are less well understood. Changes in habitat structure associated with juniper expansion may influence predator-prey interactions, and increased abundance of avian predators for sage-grouse, including common raven (*Corvus corax*) and red-tailed hawk (*Buteo jamaicensis*), have been linked to declines in sage-grouse populations. Increased predator abundance as a result of juniper expansion has been one justification for habitat restoration projects including removal of juniper in areas historically dominated by sagebrush shrubs. However, uncertainty remains over how

juniper expansion affects occurrence and habitat use of avian predators. To address this uncertainty, we implemented a multi-year study that will examine avian predator occupancy patterns both before and after the removal of juniper as part of the Bruneau-Owyhee Sagebrush Habitat project. From 2017-2019 we conducted occupancy surveys (n=299) for the avian predator community in Owyhee County, Idaho. Surveys were conducted before the removal of juniper across 30,000 acres where juniper has since been removed in support of sage-grouse conservation. Using a Bayesian dynamic multi-season occupancy framework, we estimated occupancy as a function of juniper cover composition and other habitat variables. Our data will help to inform future habitat restoration efforts by explicitly quantifying the effects of habitat gradients on species occupancy and associated community composition.

Yurick, J.[1,2], T. Jolley[1,2], STEVEN ALSUP[1,2], J. Weldon[3], A. Dickson[2], L. Dunn[1], M. Stuber[4], and D. Perkins[5]. [1]Birds of Prey NCA Partnership, Boise, Idaho 83705; [2]Boise State University, Boise, Idaho 83705; [3]Bureau of Land Management, Boise, Idaho 83705; [4]U.S. Fish and Wildlife Service, Portland, Oregon 97232; [5]College of Western Idaho, Nampa, Idaho 83687. BREEDING ECOLOGY AND HABITAT SUITABILITY OF FERRUGINOUS HAWKS (*BUTEO REGALIS*) IN SOUTHERN IDAHO.

Ferruginous Hawks are the largest North American buteo and are avian apex predators known to inhabit grassland and shrub steppe ecosystems in western United States. Their apparent sensitivity to a variety of ecological parameters associated with climate change and increasing anthropogenic landscape change makes them an appropriate indicator species of ecosystem health. In the Great Basin, widespread habitat alteration associated with invasive annual grasses, increased fire frequency, and increasing anthropogenic encroachment within breeding habitats have been suggested as drivers of breeding population declines. Currently the Ferruginous Hawk is listed as a “Species of Greatest Conservation Need” by the Idaho Department of Fish and Game and as a “Type II Sensitive Species” by the Bureau of Land Management, with the loss of suitable habitat listed as a primary threat. Despite this status, there is little published information available on the distribution, demography and reproductive performance of Ferruginous Hawks in southern Idaho. To better understand the characteristics of southern Idaho’s breeding population, we established a long-term collaborative monitoring program in 2016 to provide baseline data on the ecology and population demography of Ferruginous Hawks in and around the Morley Nelson Snake River Birds of Prey National Conservation Area. From 2016-2019 we monitored approximately 80 breeding territories, and documented territory occupancy and productivity between March and July. We used multivariate generalized linear models with model selection procedures to evaluate the relative importance of ecological attributes and human disturbance agents on Ferruginous hawk nesting success. Preliminary results indicate that daily survival rates are similar for nesting attempts on transmission towers and for attempts on free-standing platforms. Additionally, human disturbance variables may be important predictors of daily survival rates. Here, we present the results of our monitoring effort and preliminary models, and we discuss their implications for Ferruginous Hawk breeding ecology and management.

ZENGER, NOELLE*[1], B. Twede[1], J. Zenger[1], J. Whiting[1], E. Billman[1], D. Pennock[2], and D. Englestead[3]. [1]Brigham Young University-Idaho, Rexburg, Idaho 83440; [2]Idaho Falls Zoo, Idaho Falls, Idaho 83401; [3]Bureau of Land Management, Idaho Falls, Idaho 83401. DISTRIBUTION AND HABITAT USE OF THE ST. ANTHONY DUNES TIGER BEETLE.

The St. Anthony Dunes tiger beetle (*Cicindela arenicola* Rumpp) is endemic to 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 2018, we re-examined the distribution of adults and larval burrows within the St. Anthony Sand Dunes and compared that information with the distribution from a 2013 study. We also examined the distribution of beetles in historical dune habitats in Idaho Falls. In 2019, we monitored adult and larval density in areas of high, moderate, and low off-road vehicle use and identified habitat selected by larvae in those areas. We hypothesized that beetle distribution had not changed between 2013 and 2018, but that population density would be lower in areas of high ORV use. We also hypothesized that a combination of many factors determined larval habitat selection. Tiger beetles were recorded in 10% more plots in 2018 than 2013 in the St. Anthony Dunes, and beetles were recorded in historic habitat in Idaho Falls. Population density of adults or larvae did not differ between high, moderate, and low levels of ORV use. Tiger beetle larvae were documented in many areas with differing amounts of vegetation cover, substrate composition, and soil compaction. Preliminary analyses indicate that beetles selected for a combination of forb cover and fine gravel. 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.

IGNITE PRESENTATION ABSTRACTS

BARTHOLOMEW, ERIK. Idaho Department of Fish and Game, Pocatello, Idaho 83204. CRP-SAFE AND COLUMBIAN SHARP-TAILED GROUSE IN SE IDAHO.

There are several changes occurring with the CRP program nationally. The effects of these changes and the potential impacts to upland species, particularly CSTG, will be discussed.

BECK, JASON, A. Owsiak, and S. Hart. Idaho Department of Fish and Game, Pocatello, Idaho 83204. ALIGNING GRAZING TO BENEFIT FISH AND WILDLIFE.

Livestock grazing is part of the western landscape and will continue to be. Whether grazing is good or bad depends on a host of factors, including timing, duration, location, grazing history, current habitat, desired outcomes, and some species may benefit while other suffer. We have completed the first year of a project to realign grazing to better meet fish and wildlife objectives through a cooperative grazing exchange on the Blackfoot River Wildlife Management Area and adjacent private lands to benefit fish and wildlife. We will discuss how we used a complex of techniques to provide benefits to species ranging from fish to big game and how we protected hey wildlife habitat within grazing pastures from detrimental grazing. Some highlights include realigning grazing timing to match fish and wildlife objectives has already reopened spawning areas that had been unavailable due to sedimentation for decades. We also had success in using deadfall, grazing duration, and supplement location to eliminate aspen browsing within a grazed pasture. Fish and Wildlife response will take several more years, but habitat indicators are already much more favorable.

FELTS, BRANDI[1], T. Ball[1], M. Pruss[2], M. Perion[3]. [1]Idaho Department of Fish and Game, Lewiston, Idaho 83501; [2]U.S. Forest Service, Kamiah, Idaho 83536; [3]Idaho Department of Fish and Game, Idaho Falls, Idaho 83401. WHERE'S YOUR ASPEN?

Aspen (*Populus tremuloides*) is arguably the most ecologically important habitat-type as it provides nesting and foraging sites for an incredibly diverse array of wildlife species. Altered fire regimes and subsequent conifer encroachment has been attributed to aspen declines throughout much of its range. Further, it is believed that aspen is likely to constitute considerably less than 1 percent (approximately 16000 ha) of the Nez Perce-Clearwater National Forest (NPCNF). Due to the rare occurrence and general inaccessibility of aspen on the NPCNF, management activities have yet to focus on aspen as a resource target. Idaho Department of Fish funded and conducted fixed-wing aerial surveys to identify aspen throughout the most of the NPCNF. We documented over 400 aspen stands, and efforts are underway to digitize stands, develop aspen stand assessments and assign appropriate treatment prescriptions for stand restoration. We intend to present this project to NPCNF staff and conduct all aspects of project implementation and monitoring in the coming years. Successful collaborations that leverage state and federal resources and allow cross-boundary project implementation are critical to large-scale habitat restoration projects.

KRISTOF, ANDREA, and B. Wehausen. Camas National Wildlife Refuge, Hamer, Idaho 83425. BEHIND THE BULRUSH: THE FIRST TWO HUNDRED DAYS OF SWAN TRACKING IN THE GREATER YELLOWSTONE.

Within the Intermountain West, the tristate area of Idaho, Montana, and Wyoming supports the U.S. breeding segment of the Rocky Mountain Trumpeter swan population. Over the last two decades, the growth of this segment appears to be driven by steady increases in the Wyoming and Montana flocks. By contrast, the Idaho flock has shown no significant trend in annual growth and concerns are mounting that we may be witnessing the onset of a decline. Each year, an estimated 50-75% of Idaho flock nesting attempts occur at three refuges within the Southeast Idaho National Wildlife Refuge Complex. Initial investigations cited insufficient cygnet survival but subsequent banding and alpha-numeric collaring efforts have also drawn into question rates of adult and fledgling overwinter survival and site fidelity. We know very little about the off-refuge movements, survival, and site fidelity of these refuge swans, which confounds our ability to identify factors contributing to flock decline. Therefore, we seek to better understand whether the disappearance of refuge swans is due to mortality or emigration through collecting information on wintering locations, survival, and nesting/molting site fidelity. In July 2019, we deployed four Ornitela GSM-GPS tracking collars at each of four refuges in the Greater Yellowstone Ecosystem to test whether this technology will provide the battery life and data upload frequencies necessary to gain insight on these conservation questions. During the first two hundred days of deployment, we have observed regular upload frequencies and good battery health from three of the four collars. We will continue to monitor these birds for collar-associated swan mortality (due to icing), battery health, and upload frequencies throughout the winter. If they perform acceptably, we aim to deploy another 4 to 5 collars in the near future.

OWSIAK, ANNA, J. Beck and M. Pacioretty. Idaho Department of Fish and Game, Pocatello, Idaho 83204. FORGING ALLIANCES IN A BOX CHECKING WORLD.

Conservation work needs partnerships if we want on-the-ground successes to happen. Have you ever struggled to get a partnership off the ground? Do you have big dreams to do needed conservation work that just aren't getting anywhere? Maybe it's time to take a different path, one that creates opportunity for partnerships to develop. This presentation will look at some lessons learned about what successful partnerships need, an example of what is being achieved with one, and the concepts will be illustrated with current and vintage movie and television stills.

PACIORETTY, MARIA. Idaho Department of Fish and Game, Pocatello, Idaho 83204. HIGH INTENSITY WINTER GRAZING AS A TOOL FOR WMA VEGETATION MANAGEMENT.

IDFG staff and willing ranchers partnered together to implement a unique winter season cattle grazing experiment to address a growing biomass issue on the Sterling Wildlife Management Area, near the city of Aberdeen in Eastern Idaho, USA. Using hot wire grids, cattle were herded every 4-7 days over a 30 day period with the WMA objective of uniformly removing overgrown and senescent upland grass and marshland vegetation. Uniform reduction of the senescent biomass and thick duff layers was targeted to try and stimulate habitat production and provide

benefits to multiple WMA wildlife species for the following growing season. The project was successfully implemented December 2019- January 2020, with approximately 250 dry cows over a 90 acre section of SWMA.

RYDALCH, JOSH. Idaho Department of Fish and Game, Idaho Falls, Idaho 83401. IDAHO'S MOOSE MANAGEMENT PLAN.

Shiras Moose (Alces alces shirasi) occur across much of Idaho, except for the southwest corner of the state. Moose are highly valued by both hunters and non-hunters, providing consumptive and non-consumptive opportunities that have economic and aesthetic value. Over the past century their known range has expanded from small areas of northern and eastern Idaho to their current distribution. Population size also increased during this time, likely peaking around the late 1990s or early 2000s. The Idaho Department of Fish and Game (IDFG) is concerned that current survey data, anecdotal information and harvest data indicate moose have recently declined in parts of the state. Several factors may be impacting moose populations both positively and negatively including predation, habitat change (e.g., roads, development, timber harvest), changing climate, disease or parasites and combinations thereof. The intent of the Moose Management Plan is to provide guidance for IDFG and their partners to implement management actions that will aid in protection and management of moose populations and guide harvest season recommendations for the next 6 years. This plan directs IDFG to maintain or increase moose populations and hunting opportunities across the state. To accomplish this goal, IDFG has identified statewide management directions and strategies. IDFG will engage partners interested in moose management including hunters, federal and state agencies, conservation organizations, tribes and other interested individuals and groups as this plan is implemented. Partnerships can help IDFG accomplish goals to maintain sustainable populations, healthy habitat and hunting opportunity. We divided the moose distribution into 20 Data Analysis Units (DAUs) based on our current knowledge of habitats, distribution and connectivity among populations, harvest, and other management concerns (e.g., social tolerance). Statewide moose management direction in this plan includes: Increase our knowledge of moose survival, recruitment, predation, habitat use, migration, genetics and the impacts of disease, habitat changes and recreational activities; Improve the quality of moose population monitoring data to better evaluate population trends; Create guidelines for moose translocations; Collaborate with private landowners and land management agencies to incorporate measures in land use and resource management plans that benefit moose; Provide harvest opportunity while maintaining stable to increasing moose populations statewide.

POSTER PRESENTATION ABSTRACTS

BEALL, CHLOE*, L. Waits, and S. Nerkowski. University of Idaho, Moscow, Idaho 83843.
COLUMBIA BASIN PYGMY RABBIT WINTER FIELD SAMPLING AND GENETIC MONITORING.

The endangered Columbia Basin pygmy rabbit (*Brachylagus idahoensis*) population in central Washington has declined significantly in response to habitat loss and fragmentation. In 2001, sixteen Columbia Basin pygmy rabbits were taken from the last remaining population to start a captive breeding program, and four Idaho rabbits were added to counteract the effects of inbreeding. Rabbits were moved to semi-wild breeding enclosures in 2011 where additional rabbits were translocated from other states (Nevada, Oregon, Utah and Wyoming). Since then, about 1,947 mixed ancestry rabbits have been released into the wild. This research contributes to the US Fish and Wildlife Service pygmy rabbit recovery program overseen by the Washington Department of Fish and Wildlife (WDFW) by using noninvasive genetic monitoring to provide insight into population estimation methods. This research seeks to answer the following questions: How many active burrows are detected in the focal winter sampling area? How many pygmy rabbits are identified from fecal pellets collected in this area? What is the ratio between the number of rabbits detected and the number of active burrows detected? We performed transect searches to locate active burrows and collected fecal samples for genetic analysis. Species identification was conducted using mitochondrial DNA and individuals were identified using 6-8 nuclear DNA microsatellite loci. We collected 8 samples at Beezley Hills, 15 samples at Chester Butte, and 216 samples at Sagebrush Flats. We identified 3 known and 1 new rabbit in the Beezley hills study area, 6 known rabbits in the Chester Butte site, and 125 new wild born individuals and 15 previously identified individuals in the Sagebrush Flats site. Based on these data (150 individuals at 239 burrows), there is an average ratio of 0.628 rabbits per burrow across all sites, 0.648 at Sagebrush Flats, 0.500 at Beezley Hills, and 0.400 at Chester Butte.

BERGEN, SCOTT, J. Berg, and M. Hurley. Idaho Department of Fish and Game, Pocatello, Idaho 83204.
PROCEDURES FOR IDENTIFYING AND ESTIMATING MULE DEER MIGRATION IN SOUTHERN IDAHO.

Under Secretarial Order 3362, the Dept. of the Interior has promoted analysis of mule deer, elk and pronghorn antelope across the 11 western states. In 2018, USGS scientist coordinated the development of established methodologies to provide these western states with a roadmap for estimating and delineating population level migration routes. This poster runs through the steps needed to transform point location data into population level analyses of 14 mule deer migrations occurring in southern Idaho. Once location data is collected and cleaned, the data is entered into a Net-Squared Displacement (NSD) where the individual's movement through time identify winter and summer ranges connect by spring and fall migration paths. Once identified, individual spring and fall migrations use Brownian Bridge Movement Models (BBMM) to create a Utilized Distribution (UD) spatial model of the individual's probable use of areas in vicinity of the migration path. These multiple migration UD are then 'normalized' to produce a single UD of the seasonal migrations. These normalized individual UDs are then collected for all individuals

that have used a common winter range and summed for 'footprint' and normalized UD probability values. The collected 'footprints' are the analyzed and classified into the classes of single use, 2 individuals to 10%, 10 to 20%, and greater than 20%. The accumulated probability UDs are used to estimate stopover (forage and resting locations within a seasonal migration) locations by selecting those areas that comprise the highest 10% of the recorded probabilities. These steps are addressed in a sequential 'work flow' order where specific examples of each of the sub-methodologies are addressed.

BRIDGES, VERONICA*[1], C. Espinosa[1], D. Roon[2], and L. Waits[2]. [1]Universidad Tecnica Particular de Loja, San Cayetano Alto, Loja, Ecuador; [2]University of Idaho, Moscow, Idaho 83843. EXPLORING METHODOLOGIES ON HOW TO ANALYZE AVIAN BIOACOUSTIC RECORDINGS IN THE TROPICAL DRY FOREST IN ECUADOR.

Bioacoustic monitoring can provide valuable information on species within ecosystems and is growing in use among researchers. Typical surveying techniques of avian species are often invasive (such as with mist nets) and can result in stress, injury, and sometimes mortality. Avoidance of nets by birds is also common and therefore can lead to inaccuracies in the presence of a species. Human listening efforts can be limited by spatial and temporal factors and it can also be difficult to attain data on elusive species. Researchers often underutilize bioacoustic monitoring even though it can be an important tool to address concerns of biodiversity in ecosystems. A lack of protocol for processing data obtained through autonomous recording units can also make the application for this technique highly variable. Software programs such as Raven, Avisoft, and program R are often used for processing acoustic recordings, however finding the best program for target research questions is still being examined. Here we explore methodologies using cluster analysis with Kaleidoscope software by processing recordings sampled from three sites in the tropical dry forest in Zapotillo, Ecuador. Avian acoustics were recorded using the Wildlife Acoustics Song meter 3 at a frequency of 150 seconds every 15 minutes for 24 hours for 3 days total per site. By building an advanced classifier within Kaleidoscope, we can train the software to categorize similar individuals into clusters, which can be subsequently used to process recordings within the same ecosystem. By exploring this methodology, we can make better assessments on whether this is a viable technique to accurately detect avian diversity and activity patterns in the tropical dry forest in Ecuador.

CALL, JESSICA*[1], JOSEPH GALANTI*[1], AMBER JOHNSON*[1], J. Whiting[1], R. Walker[2], and L. Peterson[2]. [1]Brigham Young University-Idaho, Rexburg, Idaho 83440; [2]Idaho Department of Fish and Game, Idaho Falls, Idaho 83401. EFFECTIVENESS OF AERIAL AND PLUG SEEDING FOR BIG SAGEBRUSH (*ARTEMISIA TRIDENTATA*) AFTER THE HENRY'S CREEK FIRE.

Wildfire is a natural occurrence in the Great Basin, burning nearly 20,000 km^2 every year. Many species depend on sagebrush (*Artemisia tridentata*) habitat, making reestablishment of sagebrush important. In an effort to restore sagebrush, seeding after wildfires has become common. In 2016, the Henry's Creek Fire burned two-thirds of the Tex Creek Wildlife Management Area (TCWMA). In 2017, the Idaho Department of Fish and Game (IDFG) began restoring sagebrush

in the TCWMA using multiple methods. We compared the effectiveness of aerial seeding, plugging, and natural recovery of sagebrush in the TCWMA. From September to November 2019, we randomly selected 111 plots to quantify sagebrush density and height using 50m transects. We categorized our study area by elevation into an upper and a lower region. We also quantified an index of ungulates by counting fecal piles within transects. Sagebrush density did not differ in the upper region. In the lower region, however, density was higher in the treated groups than the untreated group. In both regions, no difference in height existed. Twice as many elk (*Cervis canadensis*) fecal piles occurred in the lower region as the upper region. Contrary to our predictions, the upper region height and density did not vary by treatment, but density in the lower region varied by treatment. Our results may be due to factors we did not measure such as aspect, precipitation, slope, and soil type. These results can help IDFG understand how these methods can be effectively used to restore sagebrush in southeastern Idaho.

CINELLO-SMITH, MIA*[1], C. Robinson[1], Z. Szymczycha[1], D. Weedop[1], M. Sonnen[1], L. Blackburn[1], D. Perkins[1], F. Kilkenny[2]. [1]College of Western Idaho, Nampa, Idaho 83687; [2]U.S. Forest Service, Boise, Idaho 83702. PHENOLOGICAL AND MORPHOLOGICAL VARIATION AMONG WESTERN SHOWY MILKWEED (*ASCLEPIAS SPECIOSA*).

Western monarch butterflies (Danaus plexippus) have declined ~97% from historic abundances in the early 1980s and are being evaluated for listing under the federal Endangered Species Act. Habitat loss and fragmentation in wintering, migratory, and breeding areas are considered key drivers of declines. Since monarchs depend on milkweeds (Asclepias speciosa) for reproduction, there is increased interest among conservationists to plant milkweeds as habitat restoration. Among milkweeds in the Western US, showy milkweed (Aslceipias sp.) has a broad ecological niche and is the most abundant milkweed and species; making it a good candidate for restoration activities. Successful habitat restoration will require germplasm that is adapted for target restoration environments and seasonal phenology. Phenological and morphological traits are adaptive, easily observable, and shaped by climate; making them helpful in genecological applications for determining seed transfer zones. We evaluated phenological and morphological variation among 35 showy milkweed populations from across the Intermountain West to determine geographic patterns of adaptive traits and their relationships to local climates using a common garden approach. We used remotely sensed climate data in conjunction with growth and reproductive phenology data to identify variation in adaptive traits and correlate them to elevation and climate variation. Here we present the results of our analyses and their implications for defining seed transfer zones for showy milkweed in the context of monarch butterfly conservation.

CONNOLLY, AARON*[1], J. Arp[1], K. Bahruth[1], H. Ware-Carlisle[1], D. Perkins[2], and S. Finn[3]. [1]Boise State University, Boise, Idaho 83725; [2]College of Western Idaho, Nampa, Idaho 83687; [3]Golden Eagle Audubon Society, Boise, Idaho 83707. COMMUNITY DRIVEN HABITAT RESTORATION ON AN URBAN RIVER CORRIDOR: RESULTS FROM YEAR 1.

The Intermountain Bird Observatory, Golden Eagle Audubon Society, Treasure Valley Native Plant Network, Boise State University, College of Western Idaho and the Idaho Department of

Fish and Game initiated habitat restoration along a 20 acre stretch of the Boise River in 2018. With the intent to improve practices, 45 experimental plots were planted with 2,070 seedlings of 22 native shrub and forb species. To facilitate planting such a high number of seedlings, a volunteer planting day was organized in October of 2018. During the summer of 2019, weekly watering and weeding was performed to encourage seedling growth and data was collected on seedling survival. Here we present data on overall survival between three different habitat zones, and key findings of species-specific survival variation among plots. These results will inform future restoration decisions at this site as well as a network of other restoration sites along the Boise River corridor.

DRUIN, LYDIA*, S. Gilbert, L. Waits, J. Adams, and B. Bennetsen. University of Idaho, Moscow, Idaho 83843. EFFECTS OF HABITAT RESTORATION ON DENSITY AND HABITAT SELECTION OF SITKA BLACK-TAILED DEER IN THE TONGASS NATIONAL FOREST, SOUTHEAST ALASKA.

Sitka black-tailed deer *(Odocoileus hemionus sitkensis)* are the northwestern-most mule deer subspecies and are of high socioeconomic and ecological importance in Alaska's temperate coastal rainforest. This species relies on old growth forest stands aged >150 years old for shelter and forage availability during deep-snow winters, but much of these forests have been logged throughout southeast Alaska, including over 40,000ha on Prince of Wales Island. Resulting successional stages >20 years old have reduced forage availability due to closed canopy, even-aged stands, and deer have declined in density in these areas as a result. To mitigate or reverse the effects of canopy closure, canopy gap treatments been shown to increase forage on the landscape through increasing light on the forest floor and subsequent understory growth. However, deer density and habitat selection response to these gaps is unknown. To fill this gap in knowledge, we collected spatial capture-recapture data via fecal DNA for an estimated 50 individuals in the Staney Creek watershed of Prince of Wales Island, comprising both a canopy-gapped treatment area and a nearby untreated control area. We will use this data to quantify the number of likely deer home-ranges in the treatment and control areas in the coming months. In combination with data from 85 motion-triggered and time-lapse cameras across the treatment and control areas, this his data will provide insights on deer density in and selection for gap, matrix or control forest. Our results will provide new insight into the efficacy of this habitat restoration treatment for deer, the target species of these treatments.

FLETCHER, TAYLOR*, J. Karl, and C. Conway. University of Idaho, Moscow, Idaho, 83843. USE OF GLOBAL POSITIONING SYSTEM COLLARS TO ASSESS THE IMPACT OF LIVESTOCK GRAZING ON THE GREATER SAGE-GROUSE.

Current estimations of livestock utilization rely largely upon infield measures that may be time consuming, cost prohibitive or imprecise. To combat this, we deployed Global Positioning System (GPS) collars to more accurately and consistently measure the effects of livestock grazing on wildlife demographic traits and landscape condition. Our objective was to use low-cost GPS collars to test for evidence of an influential relationship between livestock distribution and movement and Greater Sage-Grouse (Centrocercus urophasianus) nesting behavior. More

specifically, our aim was to quantify livestock impact on female sage grouse nest site selection and nest fate. Approximately 150 GPS collars were allocated amongst three study sites within the ongoing Idaho Grouse and Grazing project where sage grouse demographic data was being concurrently collected. Collars were randomly assigned to individuals within herds in spring grazed pastures with start dates ranging from early-April to mid-May. Collars were left on for the duration of the herd's time in the pasture, with location data taken every ten minutes and saved to a data card. A map of estimated livestock use was generated for each collared pasture. Use was determined by creating a 30x30 meter grid for each pasture and summing the fixes within each grid cell. Two different metrics for use were applied. The first, included all fixes obtained from the collars with the intention of including all livestock activities (grazing, traveling, loafing). The second metric excluded fixes obtained during nighttime hours and extended stationary periods with the intention of excluding all non-grazing activities (traveling and loafing). Maps of estimated livestock will be compared to known female sage grouse nesting locations and fates.

FOSTER, SAM*. University of Idaho, Moscow, Idaho 83843. WILDLIFE WINNERS AND LOSERS IN A CHANGING WORLD: DISENTANGLING THE EFFECTS OF LANDSCAPE DISTURBANCE AND COMMUNITY INTERACTIONS ON MULE DEER BEHAVIOR AND HABITAT SELECTION.

In forested ecosystems of Western North America, mule deer (*Odocoileus hemionus*) are an iconic but mysteriously declining species. Using motion-sensing cameras (n = 160) deployed across 3 regions in British Columbia, we will quantify how mule deer behavior and habitat selection are influenced by interactions with human users and multiple species of predators and ungulate competitors. Moreover, we will evaluate these interactions in the context of major sources of landscape change – asking how wildfires, timber harvest, and roads drive community interactions to elucidate how rapidly changing landscapes may be driving declines in mule deer populations. Our camera grids were allocated across mule deer summer and winter ranges (determined using GPS collar data) in three regions differing in areal extent of wildfire, timber harvest, and road density. Within each region, cameras were randomly placed within grid cells (1 x 1 km^2) using stratified random sampling. Sampled grid cells were selected by calculating cell-averaged raster data values of disturbance types (i.e. wildfire within 0-15 and 16-35 years, logging within 0-15 years, logging or wildfire within 36-75 years, high road density) and cameras were then randomly allocated among cells representing the top 95% of each strata (in addition, 25% of cells were selected randomly). To evaluate local and landscape scale effects within each stratum, we deployed 50% of cameras directly within the targeted strata (e.g., camera placed inside of a <15-year-old burn) while the remaining cameras were randomly deployed. We will use the camera data to evaluate effects of landscape change on mule deer occupancy and activity patterns, as well as mule deer co-occupancy and activity overlap with humans and multiple species of predators and competitors. Furthermore, using a pathway analysis framework, we will investigate several theorized mechanisms for landscape change to influence mule deer populations 1) directly and 2) indirectly through altered community interactions (e.g. predator-prey). Working closely with resource managers, tribal governments, NGOs, and citizen scientists, we will ensure our findings translate into management recommendations and conservation actions.

GARRETT, MOLLY*[1], S. Barbosa[1], K. Andrews[1], A. Goldberg[1], P. Hohenlohe[1], C. Conway[1,2], and L. Waits[1]. [1]University of Idaho, Moscow, Idaho 83844; [2]U.S. Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit, Moscow, Idaho 83844. EVALUATING GENETIC DIVERSITY AND DISTINCTIVENESS OF NORTHERN AND SOUTHERN IDAHO GROUND SQUIRREL POPULATIONS USING ADAPTIVE AND NEUTRAL LOCI.

The endemic northern Idaho ground squirrel (*Urocitellus brunneus*, hereafter NIDGS) and southern Idaho ground squirrel (*Urocitellus endemicus*, hereafter SIDGS) have recently been distinguished as separate species. These two species are morphologically distinct, occupy different habitat types, and do not interbreed. NIDGS is a federally listed endangered species and SIDGS is a state listed species of conservation concern. However, recent modeling efforts have indicated SIDGS may be more susceptible to future habitat loss and fragmentation than NIDGS. Previous work on these species has suggested population persistence may be highly dependent on locally adapted genotypes. Recent work from our research group used genomic methods to provide novel information on neutral and adaptive genetic diversity and differentiation within and between populations of NIDGS and SIDGS. Genetic samples were collected from 304 Idaho ground squirrels using buccal swabs and were used for Restriction Site Associated DNA Sequencing (RADSeq) to identify 7,197 single nucleotide polymorphism (SNP) loci. A clear genetic separation between NIDGS and SIDGS for both adaptive and neutral loci was observed, with elevation being the main variable explaining adaptive differences. However, this study evaluated NIDGS and SIDGS together, limiting the scope of this research to broad-scale variation. Furthermore, this study used samples collected from a limited range of the geographic distribution of each species. To further understand which factors are influencing differentiation and connectivity at smaller scales and to estimate key demographic variables like effective population size, we plan to develop a genotyping panel from neutral and adaptive SNPs. This SNP panel will then be used to genotype archived samples of both species to expand the geographic coverage of this genetic dataset. Analyzing these species separately with increased sample sizes will provide more powerful approaches to understand gene flow, local adaption, and metapopulation dynamics in each species.

HAMMOND, KEEGAN*, and J. Whiting. Brigham Young University-Idaho, Rexburg, Idaho 83440. MIGRATORY TRUMPETER SWAN WINTER HABITAT UTILIZATION NEAR REXBURG, IDAHO.

Trumpeter Swans (*Cygnus buccinator)* were historically located throughout the western United States and Canada. Swan populations were rapidly reduced by commercial and subsistence harvest in the 1800s. By 1900, there were only three highly congregated breeding populations left. Since 1980, the focus for swan recuperation has been to expand their winter distribution. Thousands of Trumpeter Swans migrate from Canada and Alaska to fields surrounding the Henrys Fork of the Snake River, Idaho, each year. We quantified biotic and abiotic factors that influenced the use of habitat types by swans in the Henrys Fork. We predicted that swans were utilizing fields with remnant crops more than fields with no crops remaining. We surveyed two routes weekly from February to March 2018-2020 and recorded abiotic and biotic factors, including swans counts and field type utilized. Trumpeter swans did not utilize different field types ($p=0.62$). However, Trumpeter Swans were only observed within one mile of the Henrys

Fork of the Snake River. This potentially could change when crops are rotated, weather is less severe, or snow depth increases.

HERNANDEZ, MAURO, and T. Stefanic. Craters of the Moon National Monument and Preserve, Arco, Idaho 83213. INVENTORY AND MONITORING OF BAT MATERNITY COLONIES ON CRATERS OF THE MOON NATIONAL MONUMENT AND PRESERVE AND SURROUNDING AREA (WHAT WE LEARNED IN YEAR 1).

We monitored 20 caves in 2019 for evidence of bat maternity colony use. Six historic maternity colony sites and 14 caves suspected to have potential to house maternity colonies. We deployed HOBO data loggers and guano collection boxes in these caves before the start of the maternity season. During the maternity season we used a digital boroscope to view bats in these caves without having to enter and disturb maternity colonies and acoustic detectors to capture bat calls at the cave entrances. We conducted out flight surveys at these caves using a night vision camera with an infrared kit. We confirmed several historic Townsend big-eared bat (*Corynorhinus townsendii*) maternity colonies were active in 2019 and discovered 3 new western small-footed myotis (*Myotis ciliolabrum*) maternity colony sites. We have much call data and video to analyze and guano has yet to return from the lab with species identifications but we will discuss what worked, what didn't and where we go from here.

KAHLER, ALEXANDRA*[1,2] and C. Goldberg[1]. [1]Washington State University, Pullman, Washington 99164; [2]Wild Otters Research Private Limited, Belbata-Chorao, Tiswadi, Panjim, Goa 403102; INVESTIGATING THE DISTRIBUTION OF THE SMOOTH-COATED OTTER (*LUTROGALE PERSPICILLATA*) USING ENVIRONMENTAL DNA.

The analysis of environmental DNA (eDNA) can be an effective tool for detecting the presence of elusive or low-density organisms. Although this technique has been utilized in many ecosystems, it has yet to be applied in mangrove ecosystems to detect aquatic mammals. Extreme environmental conditions (heat, salinity, turbidity) pose challenges for detection of rare species using eDNA in mangrove systems. We conducted a pilot study to test the sensitivity of eDNA methods for detecting the Smooth-coated otter (*Lutrogale perspicillata*; IUCN classification: Vulnerable) in mangrove ecosystems in India. This species can be difficult to monitor due to its elusiveness and the challenges of working in these complex systems. Over 11 weeks, we collected 30 water samples where positive signs of *L. perspicillata* were noted around Chorão Island in Goa, India, filtering on-site immediately after collection. We designed and validated a species-specific, probe-based quantitative PCR assay for this species and used it to detect DNA of *L. perspicillata* in the filtered samples. We found our assay to be effective in detecting *L. perspicillata* within the mangrove ecosystem of Goa; however, the results suggest that the detection probability likely decreases with time and could be affected by tidal movements. This method could provide a sensitive, efficient way to detect elusive semi aquatic or aquatic species in mangrove systems.

KRISTOF, ANDREA[1], B. Wehausen[1], and J. Barnett[2]. [1]Camas National Wildlife Refuge, Hamer, Idaho 83425; [2]U.S. Fish and Wildlife Service, Inventory and Monitoring Program, Burbank, Washington 99323. NOISY NIGHTS IN EAST IDAHO: A BAT COMMUNITY INVENTORY AT CAMAS NATIONAL WILDLIFE REFUGE.

Bats are a diverse and ecologically significant taxonomic group whose beneficial services include the consumption of large quantities of nocturnal insects, many of which are forest and crop pests. Today, they face multiple unprecedented threats, including wind power development, habitat loss, climate change, and most recently the novel disease White-nose Syndrome. In order to develop effective conservation strategies, it is necessary to understand each species' distribution and use of the landscape. However, this information is relatively sparse for the bats of the northern Intermountain West. Camas National Wildlife Refuge (Refuge) in east Idaho encompasses wetland, riparian, and shelterbelt assemblages believed to be important foraging and roosting habitat for bats in the Snake River Plains. But the composition and phenology of the bat community here was undescribed. Therefore, in 2012, we conducted a two year acoustic inventory to identify bat species occurrence on the refuge. In 2014, we expanded with a five year study acoustically monitoring bat use of different habitats within the refuge boundaries. We found that the Refuge hosts a diverse bat community comprised of 11 of the 13 species known to occur in Idaho; that 6 species are common and widespread on the Refuge; that all habitat types were dominated by little brown myotis (*Myotis lucifugus);* and that the shelterbelt site hosts the greatest species diversity and reported the highest average activity rate among the sampled sites. These studies provide valuable baseline data for the bat community within the Snake River Plains of east Idaho. Furthermore, given the dominant presence of little brown myotis on the landscape combined with its known vulnerability to White-nose syndrome, this site may prove an effective location to surveil for declines indicative of White-nose syndrome in east Idaho.

MTUI, DORAH[1], S. Barbosa[1], J. Adams[1], D. Christianson[2], and L. Waits[1]. [1]University of Idaho, Moscow, Idaho 83844; [2]University of Wyoming, Laramie, Wyoming 82071. OPTIMIZATION OF NUCLEAR DNA MICROSATELLITE LOCI FOR INDIVIDUAL IDENTIFICATION OF BISON FROM GRAND CANYON NATIONAL PARK.

Across North America, bison (*Bison bison*) populations experienced extreme reductions in the early 1900s due to massive slaughter. Stringent monitoring and translocation of animals by Federal and State agencies have enabled preservation of the remaining bison population. In northern Arizona, the bison population is currently at ~600 animals and is administered by Grand Canyon National Park (GRCA) under the authority of Arizona Game and Fish commission. Their wide distribution and projected herd growth is believed to have large impacts on available park resources, which is causing concerns regarding park management. Current management efforts aim at developing intervention guidelines to allow estimation of population size over time, while improving genetic diversity and population viability. In this pilot study, we aimed at evaluating the feasibility of using non-invasive genetic sampling methods for individual identification and capture-recapture analyses for GRCA bison population. For this, we optimized a set of 12 microsatellite loci on DNA extracted from 27 bison tissue samples and used sex-linked markers for sexing. We then determined levels of genetic diversity in the GRCA herds and compared them with those observed in other North America bison herds. Analyses showed

that the observed heterozygosity averaged at 0.574 and the number of alleles per locus averaged 4.36, which is lower than the average reported for Yellowstone National Park (YNP) herds but was consistent with number of alleles per locus reported for bison population from other national parks. We determined that 7-8 loci are needed to reach a PIDsibs of <0.01 and accurately identify individuals. Our results show that allelic diversity levels are high enough in the analyzed set of loci in the GRCA bison population to proceed in applying a non-invasive genetic sampling approach. This pilot study provides valuable data on the genetic diversity of bison population in GRCA.

NANCE, BENJAMIN*, SCHNEIDER, SAMANTHA*, S. Nerkowski, and L. Waits. University of Idaho, Moscow, Idaho 83844. NONINVASIVE GENETIC TRACKING OF THE REINTRODUCTION OF PYGMY RABBITS INTO CHESTER BUTTE AND BEEZLEY HILLS WA.

The pygmy rabbit (Brachylagus idahoensis) is North America's smallest rabbit and can be found throughout the western United States. Columbia Basin pygmy rabbits (CBPR) are a sagebrush obligate species that suffered dramatic decreases in its population due to habitat loss and fragmentation in central Washington. In 2003 the isolated CBPR, was listed as a federally endangered distinct population segment. In 2001, sixteen CBPR were taken from the last remaining population in central Washington and placed in a captive breeding program along with four rabbits from Idaho to counteract the effects of inbreeding. The rabbits were then moved to a semi-wild breeding enclosure in 2011 where additional rabbits were translocated from other populations within the western United States (Idaho, Oregon, Nevada, Utah, and Wyoming). Conservation efforts to re-establish a wild population via reintroduction by the US Fish and Wildlife Service have been overseen by Washington Department of Fish and Wildlife since 2011. The use of noninvasive genetic testing of fecal pellets provides insight into genetic diversity and ancestry of the CBPR. In 2017, reintroduction efforts began on the Beezley Hills and Chester Butte Preserves outside of Ephrata, Washington. Fecal pellets were collected at both sites for DNA analysis in the winters 2018-2020. The goal of our project was to identify the number of active burrows and the number of rabbits in 2020. Identification of rabbit species was conducted using mitochondrial DNA, and 19 microsatellite loci were used for individual identification and to estimate the amount of CB ancestry. The DNA samples collected will contribute to the efforts of reintroduction of the CBPR into these regions by providing information on survival rates and reproduction success. The strategies that are being used in this study can be used as a guide for conservation and management of the species in the future.

SANCHEZ, CORINA*[1], P. Coates[2], T. Sheilds[3], M. Vaughn[4], and D. Delehanty[1]. [1]Idaho State University, Pocatello, Idaho 83209; [2]U.S. Geological Survey, Western Ecological Research Center, Dixon, California 95620; [3]Hardshell Labs, Inc., Hanes, Alaska 99827; [4]Sundance Biology Inc., Paso Robles, California 93446. REDUCING THE IMPACT OF COMMON RAVENS ON GREATER SAGE-GROUSE THROUGH EGG-OILING.

Common raven (Corvus corax, raven) populations have increased across western North America in recent decades concomitantly with increases in the availability of anthropogenic resources

which provide them with nesting and food substrates. Concurrently, Greater sage-grouse (Centrocercus urophasianus, sage-grouse) populations have experienced substantial declines in distribution and abundance. Increasing raven numbers have been linked to population declines for several species of conservation concern and they are now an important nest-predator of sage-grouse. Managed reduction of raven nest success through prevention of hatching may reduce foraging by adults, as the need to provision nestlings is removed. If so, such reductions could ameliorate raven predation on grouse nests. We hypothesize that reducing raven reproductive success through egg-oiling treatments, which causes eggs to become inviable, will improve sage-grouse nest survival. In 2019, we oiled raven eggs at two treatment sites using ground-based and drone application methods and did not oil eggs at four control sites as part of a before-after-control-impact experimental design. Sage-grouse nest survival was estimated during the treatment year at all sites as well as three years before initiation of treatments. Additionally, we measured incubation patterns of ravens to identify impacts of egg-oiling on incubation recesses, constancy (% time incubating eggs), and duration. Preliminary results indicate an average increase in sage-grouse nest survival by approximately 21% at treatment sites while control sites either declined in survival or did not change. Results will be used to develop management actions for reducing the impact of ravens on sage-grouse and other sensitive prey and potentially provide novel insights into raven breeding biology. Findings are preliminary and provided to meet the need for timely best science.

RANDALL, KENNETH*[,1], M. Ellison[1,2], and T. Johnson[1]. [1]University of Idaho, Moscow, Idaho 83844; [2]Nancy M. Cummings Research, Extension, and Education Center, University of Idaho, Carmen, Idaho 83462. RESOURCE RESPONSES IN GREATER SAGE-GROUSE BROOD-REARING HABITAT TO LIVESTOCK GRAZING.

Mesic meadow systems across the western United States play an integral role in providing unique water and forage resources for ranching operations and wildlife species. Due to a limited presence on the landscape, the value of mesic meadows to both groups is significant. Greater sage-grouse (*Centrocercus urophasianus*, hereafter, sage-grouse), an Idaho Species of Greatest Conservation Need, rely upon these habitats during brood-rearing because mesic meadows support diverse communities of forbs, an essential part of sage-grouse diets. Livestock grazing of mesic meadow plant communities and soils may elicit indirect effects on sage-grouse populations reliant upon these communities. Understanding how livestock grazing influences key features of sage-grouse brood-rearing habitat will help inform management decisions on rangelands that provide wildlife habitat and livestock production within mesic meadows. We established 15 pastures at Rinker Rock Creek Ranch in south-central Idaho and stocked them with yearling heifers to evaluate the effects of timing and intensity of grazing in short-duration trials. We evaluated moderate (30-40%) and high (70-80%) grazing utilization in six pastures in June (16 days) and six pastures in August (16 days) (n = 3 pastures per treatment; n = 12 total). Three pastures provided controls without cattle grazing. We measured heifer performance and plant communities before grazing (< 6 days), after (< 6 days) grazing, and at the end of September to assess vegetation regrowth. We measured heifer body weight to evaluate changes in gain across grazing treatments. We measured vegetation composition, foliar cover, the average height of vegetation by species, biomass, and soil moisture and will compare among our experimental treatments and against other sites where livestock grazing was continuous during

the growing season. Analyses of these data will provide greater insight into the relationship between livestock grazing and food resources for sage-grouse brood-rearing in mesic meadows.

ROUGHGARDEN, JESSIE[1], C. Mosby[1], and K. Inman[2]. [1]Idaho Department of Fish and Game, Boise, Idaho, 83712; [2]Wildlife Conservation Society, Ennis, Montana 59729. INVESTIGATION OF BEAVER DEMOGRAPHSI IN SAGEBRUSH SYSTEMS OF EASTERN IDAHO AND SOUTHWESTERN MONTANA TO INFORM BEAVER TRANSLOCATIONS AND HARVEST MANAGEMENT.

The ability of American beaver (*Castor canadensis*) to modify their landscapes have far reaching effects on both riparian and hydrological systems. Across the western US, promoting this process by using beaver as a habitat restoration tool (through harvest management, translocations, and mimicry) is gaining in popularity. One challenge to this approach is that little information exists on beaver demographics and movement in the arid west, thus limiting our ability to inform translocations and harvest management, and help set expectations for beaver densities post translocations. This presentation provides an update on efforts to address this information gap. Since October 2019, ~40 beaver have been captured using cable restraints in three HUC eight watersheds in northeastern Idaho and southwest Montana. Animals were fitted with tail transmitters and weekly location data will be collected through the summer months. Thus far, much has been gained in refining capture techniques and initial movement patterns have been identified. By collecting movement data through the summer months we plan to identify sources of mortality, home range, and habitat needs to guide beaver mediated habitat restoration efforts in southern Idaho and similar settings.

RUSH, LINDSEY*[1,2], J. Rachlow[2], L. Svancara[2,3], and I. Smith[2]. [1]Bureau of Land Management, Burley, Idaho 83318; [2]University of Idaho, Moscow, Idaho 83843; [3]Idaho Department of Fish and Game, Moscow, Idaho 83843. UNDERSTANDING REGION-SPECIFIC HABITAT USE BY COMPARING SPECIES DISTRIBUTION MODELS FOR PYGMY RABBITS.

Regional variation in available habitat conditions can affect animal-habitat relationships, species distributions, and opportunities for habitat restoration and conservation. The pygmy rabbit (*Brachylagus idahoensis*) is a sagebrush obligate that is currently listed as a BLM Sensitive Species in all 11 range states. Despite occurrence records in Idaho that date back to the early 1900s, fine-scale habitat distribution maps needed to inform sagebrush conservation, including establishment of fire breaks, are lacking for much of the State. The goal of this work was to build on recent efforts in east-central Idaho to refine species occurrence data and create fine-scale, regional models of habitat distribution throughout Idaho. We created inductive species distribution models (SDM) for pygmy rabbits across Southern Idaho within 5 regional polygons. We acquired >10,000 trusted records of pygmy rabbit occurrences from across the species' range (Smith et al. 2019) and >500 additional records from biologists in Idaho, and we retained 4,412 records for analysis. We used the program Maxent to build regional models incorporating environmental layers representing climate, vegetation and land cover, topographic features, and soil characteristics. Environmental predictor variables were progressively eliminated from final model consideration, resulting in parsimonious models that reduced the spatial and sampling

biases. The regional SDMs will enhance understanding of variability in habitat selection across regions of Idaho. In addition, the regional models of predicted habitat for pygmy rabbits can be used by land managers in their respective area to prioritize locations for pygmy rabbit surveys and to identify areas for conservation or habitat restoration efforts.

SANCHEZ, ZACHARY*[1], M. Oleyar[2], and K. Vierling[1]. [1]University of Idaho, Moscow, Idaho 83844; [2]HawkWatch International Salt Lake City, Utah 84106. EVALUATING THE INFLUENCE OF LAND COVER CLASSIFICATION ON NEST SITE SELECTION, PRODUCTIVITY, AND REPRODUCTIVE SUCCESS OF AMERICAN KESTRELS (*FALCO SPARVERIUS*).

The American Kestrel (*Falco sparverius*) is a small falcon of North and South America undergoing documented declines for the last several decades based on migration count and breeding bird survey data. As predators, American Kestrels provide an essential ecosystem service, in the form of a natural pest control, and help to regulate the populations of many different species of insects and small vertebrates, particularly mammals. HawkWatch International is growing a nest box program across the Palouse region in an attempt to increase nesting opportunities for this species and study habitat-specific demography. The efficacy of this program remains uncertain as the rate of box use to date is low. A goal of our research is to increase the effectiveness of the current American Kestrel nest box program by evaluating how vegetation and land cover factors, measured at different spatial scales, influence nest box use and/or the productivity or reproductive success of Kestrel nesting attempts. We defined use as kestrel breeding pairs initiating a nesting attempt at a box (≥1 egg) and reproductive success as fledging ≥1 young. We monitored 26 boxes from March to July in 2019 and recorded placement, timing of placement, and nest visitation schedule. In addition to box and site characteristics, we measured local scale vegetation using on-the ground surveys within a 5.0 and 11.3 meter radius of each nest box. We also evaluated ground cover at the landscape scale within a 50 and 100 meter radius of each nest box using GIS analysis and 2011 NLCD land classification data at 30 meter resolution. We then compared the vegetation characteristics between 4 used and 22 unused boxes. While this is an ongoing and growing project, we intend for these data to inform the placement of future nest boxes in locations where they are more likely to be occupied by American Kestrels.

SANTIAGO-PLATA, MANUEL*, and L. Waits. University of Idaho, Moscow, Idaho 83844. LANDSCAPE FEATURES AFFECTING NEOTROPICAL OTTER PRESENCE AND FUTURE GENETIC STUDIES TO UNDERSTAND ITS DISPERSAL PATTERNS IN COSTA RICA.

The neotropical otter (*Lontra longicaudis*) is the most widely distributed species of the genus *Lontra* in the Americas with a geographic range spanning northern Mexico to Argentina. Globally this species is classified as Near Threatened with a decreasing population trend. In Costa Rica, it is listed as a protected species of concern, but there is little information on habitat requirements making it difficult to assess its population status. We studied the occurrence of otters linked to 13 habitat variables and six landscape variables within the San Juan River Basin

(SJRB) in Costa Rica. 40 sampling units of 3,600 m in length were selected randomly; these were sampled using nine sub-segments of 400 m each. Forest (45.77%) and grassland (40.53%) were the most common cover types. Occupancy modeling with Akaike Information Criterion (AIC) selection was used to assess which habitat and landscape variables best explained the occurrence of otters in the sampling sites. We estimated an occupancy probability of 72% (psi=0.72; 95% IC=0.51-0.86) and a constant detection probability of p=0.26 (95% IC=0.20-0.33) for otters in the SJRB. The best local scale habitat model included tree density and the number of trunks on riverbanks. The best model at the landscape scale included stream order and urban land use, which had a negative effect on occupancy. Otters used all stream order classifications; however, a low probability of occupancy was observed in temporary streams. A future project will be conducted across Costa Rica to evaluate the levels of genetic variation and genetic structure of neotropical otter populations to identify riverine systems features that influence the gene flow and connectivity among otter populations in the SJRB. The results of this project will increase understanding of landscape features that facilitate and restrict gene flow, and impact genetic diversity across neotropical otter ranges.

STARKEY, JEREMY*, D. Pradhan, and D. Delehanty. Idaho State University, Pocatello, Idaho 83209. BILATERAL ASYMMETRY IN GONADAL TESTOSTERONE CONCENTRATION IN BIRDS.

Birds frequently exhibit bilateral asymmetry in their reproductive tracts despite overall morphological symmetry. Most male birds have a smaller right testis relative to the left testis. Both left and right testes produce sperm and testosterone which are fundamental to male reproduction. We seek to better understand this fundamental trait in birds. Recent research has revealed the larger left testis in birds contains a greater density of spermatogenic tissue relative to the right testis. This has been interpreted as a proliferation of sperm producing tissue in the left testis and the underlying cause for the left testis to be larger than the right testis. We ask, is testosterone concentration similarly asymmetrical across left and right testes. In one game bird species, Chukar (Alectoris chukar), the amount of steroid producing tissue appears to be equally distributed between testes despite differences in size and mass between testes. Under these circumstances we hypothesize that the right testis will have a higher concentration of testosterone than the left testis because the left testis is asymmetrically enlarged for sperm production, but steroid producing tissue is equally distributed. We seek to measure this phenomenon in waterfowl and game birds to better understand reproduction and sexual selection in these important wildlife species. Prior to collecting any managed species, as proof of concept we used European Starlings (Sturnus vulgaris), as a proxy for waterfowl and game birds and we used 11-ketotestosterone as a proxy for dihydrotestosterone. We found that male starlings exhibited asymmetrical testes (right smaller) and we found higher concentration of 11-ketotestosterone in the right testis than left testis of European Starlings. Here we present detailed information on testis size, mass, and androgen concentration between male starlings collected during the breeding season prior to initiating our collection of waterfowl and game birds.

STEIN, RACHEL*, and J. Rachlow. University of Idaho, Moscow, Idaho 83843. A REVIEW OF THE ROLE OF ACOUSTICS IN THE BEHAVIOR AND ECOLOGY OF TERRESTRIAL MAMMALS.

Despite extensive work on the acoustics of marine mammals, there has been no systematic review of the role that sound plays in the behavior and ecology of terrestrial mammals. Much terrestrial research has focused on the acoustics of bats; less has considered the acoustics of other terrestrial species. The goal of this work was to synthesize existing research literature addressing the behavior and ecology of terrestrial mammals in relation to acoustics. To implement the review, we first generated a set of key words that we used to search for relevant literature in the Web of Science platform. The search results included >1100 titles from which we randomly selected 600 papers for review weighted by decade. Of these, 600 papers, ~230 were selected for review after reading the titles and abstracts. Preliminary results indicate that just over half of the papers focus on primates and more than 90% include research or discussion on acoustic forms of communication.

STITT, JESSICA*, L. Vierling, A. Hudak, and K. Vierling. University of Idaho, Moscow, Idaho 83844. SEEING THE FOREST WITHOUT THE TREES: HOW LIDAR-DERIVED CANOPY GAPS CAN INFORM SNAG MODELING AND PROVIDE VALUE TO WILDLIFE.

Canopy gaps are defined by the absence of vegetative structure and can serve important roles for wildlife, such as facilitating animal movement through a forest canopy. Often, gaps also occur around keystone structures like snags, which provide important substrates for use by multiple wildlife species for breeding, roosting, and/or foraging. Canopy gaps can be quantified using airborne lidar, which can also be used to report wildlife-related metrics such as foliage height diversity. We hypothesized that airborne lidar and canopy gap analysis could be used to improve snag modeling, in that snags will exhibit certain gap characteristics that differentiate them from their surroundings. The objective of this study was to evaluate canopy gaps around snags and around live trees to determine if there are correlations between canopy structure and snag occurrence in dense conifer stands of the Idaho Panhandle National Forest (IPNF). We used airborne lidar flown over the IPNF during 2016 and paired it with ground reference data collected at >150 fixed-radius plots during 2017 and 2018. Plot data included GPS locations of individual snags as well as characteristics of each snag (DBH, height, species, decay status) in stands where the dominant live tree species were grand fir (Abies grandis), Douglas fir (Pseudotsuga menziesii), and western hemlock (Tsuga heterophylla). To evaluate local gap structure, we extracted horizontal circular “slices” of lidar data with a radius of 3m, centered on each live tree or snag. Slices occurred at 4 heights above ground (2m, 5m, 10m, and 25m canopy heights). The R package ForestGapR was used to locate canopy gaps across each slice and generate metrics on gap extent across all heights for each sample (min. gap size=1m2). Preliminary results aligned with our expectations for conifer forests, with more gaps and larger gaps at higher canopy positions across all samples (n=232 slices total across 22 snags and 36 live trees). Our results further suggest there were more gaps around snags, regardless of height (gaps present in 76% of snag slices vs. 28% of live trees). The relationship between canopy gaps and snags was more pronounced across all metrics: 95% of snags had gaps at both 10m and 25m (while only 22% of live trees did), and gap size was 1.5x larger on average for snags.

Additionally, there was a positive correlation between gap size and snag diameter, becoming stronger as canopy height increased. These results suggest the potential to improve understanding of gap dynamics around snags, which not only can help with snag modeling, but can also improve understanding of how open space is structured in canopies in ways that may be beneficial to wildlife, such as providing greater predator detection and foraging opportunities.

TWEDE, BETHANIE *[1], N. Zenger[1], J. Zenger[1], J. Whiting[1], E. Billman[1], D. Pennock[2], and D. Englestead[3]. [1]Brigham Young University-Idaho, Rexburg, Idaho 83440; [2]Idaho Falls Zoo, Idaho Falls, Idaho 83401; [3]Bureau of Land Management; [4]Veolia Nuclear Solutions. SUMMER ENTRY BY HUMANS INTO BAT ROOSTS IN THE SAND CREEK DESERT.

White-nose syndrome is a fungal disease fatal to various species of hibernating bats. This disease has spread across the United States; however, white nose syndrome has not been documented in Idaho. Many caves in southeastern Idaho are important bat maternity roosts and hibernacula. Therefore, understanding human recreational use of these caves is important since long distance transmission of white-nose syndrome is likely caused by people visiting caves. We quantified human cave entry by setting motion-sensor cameras at six caves in the Sand Creek Desert in southeastern Idaho from May to November in 2018 and 2019. We recorded the number of visits from different user groups (i.e. cavers, hunters, and general public), the time of year that visits occurred, and the duration of those visits. We predicted that the group would visit caves the most would be recreational cavers and that the duration of their visits would be longer than other groups. We observed 52 groups visiting the caves (7 cavers, 11 hunters, and 34 general-public) with group size ranging from one to ten individuals. Hunters were only documented in October while visits from the general public were recorded every month. A wide variation in duration of visits existed (mean=10, SD= 24, range=1-123), however, cavers spent the most time in caves. Our data indicate that although the general public visit caves most often, recreational cavers spent the most time in caves. Our study provides information about human recreational use in important bat maternity roosts and hibernacula in southeastern Idaho. Our data can be used by the Bureau of Land Management with conservation of these caves.

WALKER, R.H.*[1], M. Hutchinson[2], R. Pringle[2], and R. Long[1]. [1]University of Idaho, Moscow, Idaho 83843; [2]Princeton University, Princeton, New Jersey 08544. IS INDIVIDUAL TROPHIC NICHE WIDTH DETERMINED BY STATE-DEPENDENT BEHAVIORS IN A LARGE HERBIVORE?

Many ecological models assume conspecific individuals are ecologically equivalent despite substantial empirical evidence to the contrary. The niche variation hypothesis proposes that a population's total trophic niche width (i.e., the full range of resources utilized by the population) emerges from individual-level strategies for optimizing the pressures imposed by inter- versus intra-specific competition. We conducted the most complete study to date of resource partitioning among conspecific individuals by: 1) analyzing temporal variation in diet composition and quality of a large herbivore via DNA metabarcoding, and 2) evaluating several behavioral mechanisms for generating that variation. We investigated the degree to which total trophic niche width of a population of bushbuck (a tropical, mixed-browsing herbivore;

Tragelaphus sylvaticus) emerged from the unique foraging behaviors of relatively specialized individuals within that population. We tested the hypothesis that state-dependent behaviors (i.e., behaviors determined by an animal's current physiological 'state,' or condition) are a principle mechanism generating variation among individuals by relating patterns of forage selection to measures of individual condition. We also considered inter-specific competition as a potential extrinsic mechanism generating dietary specialization by comparing within home-range densities of congeneric antelope to the niche widths of individual bushbuck. Preliminary analyses show individual diets are relatively dissimilar and diet breadth is strongly related to body condition. Results from this study will shed light on relationships between individual phenotype and population niche-space.

YOUNG, AUSTIN*, P. Giltz, and C.R. Peterson. Idaho State University, Pocatello, Idaho 83209. DIGITAL IMAGING OF AMPHIBIAN AND REPTILE SPECIMENS AT THE IDAHO MUSEUM OF NATURAL HISTORY.

We are taking digital images of amphibian and reptile specimens from the Idaho Museum of Natural History (IMNH) to make them more accessible for research and biodiversity conservation. Museum specimens provide the best source of historical data for these species. At about 2,300 specimens, the IMNH herpetology collection is the largest collection of preserved Idaho amphibian and reptile specimens in the world. This collection includes about 850 specimens formerly housed by the University of Idaho. The taxonomic composition of the collection is: 54% amphibians, 46% reptiles, 10% salamanders, 44% anurans, 0.3% turtles, 25% lizards, and 21% snakes. The oldest specimens were collected in 1951. To take digital photographs of the specimens, we used an Ortery light box, a Nikon D800 camera, and Nikkor 60 and 105 mm macro lenses. The dorsal and ventral surfaces of specimens were photographed dry on an 18% gray card with a ruler and the specimen tags visible. So far, we have photographed 7% of the specimens. The raw image files will be converted to jpg files that will be imported along with their metadata into EMu, the museum's collection management software. The files and metadata will then be uploaded to online databases such as iDigBio.