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Poster Session Abstracts

The greenscape shapes surfing of resource waves in a large migratory herbivore

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ABSTRACT: The Green Wave Hypothesis posits that herbivore migration manifests in response to waves of spring green-up (i.e., green-wave surfing). Nonetheless, empirical support for the Green Wave Hypothesis is mixed, and a framework for understanding variation in surfing is lacking. In a population of migratory mule deer (*Odocoileus hemionus*), 31% surfed plant phenology in spring as well as a theoretically perfect surfer, and 98% surfed better than random. Green-wave surfing varied among individuals, and was unrelated to age or energetic state. Instead, the greenscape, which we define as the order, rate, and duration of green-up along migratory routes, was the primary factor influencing surfing. Our results indicate that migratory routes are more than a link between seasonal ranges, and they provide an important, but often overlooked, foraging habitat. Additionally, the spatiotemporal configuration of forage resources that propagate along migratory routes shape animal movement and presumably, energy gains during migration.

Citizen Scientists Retrace Frank Craighead's Steps: Revealing Shifts in Teton-Yellowstone Plant Phenology

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ABSTRACT: Around the world, phenology —or the timing of ecological events — is shifting as the climate warms. This can lead to a variety of consequences for individual species and for ecological communities as a whole, most notably through asynchronies that can develop between plants and animals that depend upon each other (e.g. nectar-consuming pollinators or ungulates who surf the 'green wave'). Within the Greater Yellowstone Ecosystem (GYE) and Grand Teton National Park (GTNP), there is little understanding of how climate change is affecting plant and animal phenology, yet through detailed scientific and citizen science observation there is tremendous potential to further our knowledge and increase public awareness. Detailed historic data are rare, but in GTNP we have the opportunity to capitalize on phenology data gathered by Dr. Frank Craighead, Jr. in the 1970s, before significant warming

had occurred. We have gathered, digitized, and quality-controlled Craighead's observations of plant first flowering dates. First flowering date for 87% of a 72-species data set correlate significantly with spring temperatures in the 1970s, suggesting that these plants are now flowering earlier and will continue to flower earlier in the future. Our multi-year project has project has 4 primary goals: (1) initiate a citizen science project, Wildflower Watch, to train volunteer scientists to collect contemporary phenology data on certain species (2) gather further historical records of plant phenology in the region, (3) model continued phenological changes under future climate change scenarios using satellite derived climate data and on the ground observations and (4) connect to cascading effects on the overall ecosystem - possibly including nectar consuming pollinators, bear foraging, and migrating ungulates. This project simultaneously increases public involvement in climate research, collaborates with the National Park Service and the Bridger-Teton National Forest to inform management strategies, and furthers scientific understanding of ecological responses to climate change.

Examining speed versus selection in connectivity models using elk migration as an example

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ABSTRACT: Landscape resistance is a vital component of connectivity modeling and typically derived from resource selection functions (RSF). As RSFs estimate relative probability of use they tend to focus on understanding habitat preferences during slow, routine animal movements. Dispersal or migration, however, often necessitate fast, directed movements, in which case models of movement speed rather than resource selection may be more realistic for identifying habitats that facilitate connectivity. We evaluated connectivity models applied to resistance estimated from models of movement rate and resource selection. Using movement data from migrating elk, we evaluated continuous time Markov chain (CTMC) and movement-based RSF models (i.e., step selection functions [SSF]). We applied circuit theory and shortest random path (SRP) algorithms to CTMC, SSF and null (i.e., flat) resistance surfaces to predict corridors between elk seasonal ranges, and evaluated prediction accuracy by comparing model predictions to empirical elk movements.

All models predicted elk movements well, but models applied to CTMC resistance were more accurate than models applied to SSF and null resistance. Accuracy was similar between circuit theory and SRP algorithms. CTMC can be more realistic than SSF for estimating resistance for fast, directed movements, though SSF may demonstrate some predictive ability when animals also move slowly through corridors (e.g., stopover use during migration). High null model accuracy suggests seasonal range data may also be critical for predicting direct migration

routes. For animals that migrate or disperse across large landscapes, we recommend incorporating CTMC into the connectivity modeling and conservation toolkit.

Greater Yellowstone Sandhill Crane Conservation Initiative

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ABSTRACT: Teton Valley, Idaho lies near the center of the breeding range for the Rocky Mountain Population (RMP) of Greater Sandhill Cranes. Due to its central location in the Greater Yellowstone Area and ideal alignment of protected wetlands, open space, and small grain farms, Teton Valley supports both a significant breeding population and the largest pre-migration staging Sandhill Crane population in the entire Greater Yellowstone Ecosystem.

According to the Pacific and Central Flyways Management Plan for the RMP of Greater Sandhill Cranes 2016, a major segment of the RMP nests in eastern Idaho and nearly 30% of the RMP stages there in September. In Teton Valley, rapid development and land use changes in the early 2000s resulted in fragmented and degraded habitat and declining Sandhill Crane populations. Today, Teton Valley's capacity to support summering and staging cranes continues to diminish due to another increase in the pace of land use changes.

The Greater Yellowstone Sandhill Conservation Initiative is a concerted, multi-partner effort to offset the effects of habitat fragmentation and degradation on Sandhill Cranes. Goals include protecting and expanding key foraging, breeding, and roosting habitats in Teton Valley, as well as creating ways for people to connect with Sandhill Cranes and other natural resources.

To reach these goals, TRLT and its partners are working with willing farmers and landowners to protect their land and to manage it in ways that support both their livelihood and Sandhill Cranes. Strategies include; an effort to compensate willing landowners in critical areas to specifically manage for Sandhill Crane forage, conserving and restoring habitat critical for Sandhill Crane viability through conservation easements and fee-title ownership, establishment of a permanent Sandhill Crane management area, and increasing community involvement, education, and engagement to improve understanding of our region's unique wildlife.

Land Use Diversification and Intensification on Elk Winter Range in Greater Yellowstone: Framework and Agenda for Social-Ecological Research

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Amenity migration describes the movement of peoples to rural landscapes and the transition toward tourism and recreation and away from production-oriented land uses (ranching, timber harvesting). The resulting mosaic of land uses and community structures has important consequences for wildlife and their management. This poster considers the amenity-driven changes to social-ecological systems in the Greater Yellowstone Ecosystem, specifically in lower elevations that serve as winter habitat for elk. We present insights from a preliminary and exploratory mixed-methods investigation: the creation of a "social-impact" index of land use change on elk winter range and a focus group with wildlife management experts. Our findings suggest that elk are encountering an increasingly diverse landscape with respect to land use, while new ownership patterns increase the complexity of social and community dynamics. These factors, in turn, contribute to increasing difficulty meeting wildlife management objectives.

To better assess the rising complexity across social and ecological landscapes in the Greater Yellowstone Ecosystem, we develop a novel research framework, the Property-Landscape Life Course (P-LLC). The systems-inspired PLLC organizes a set of data collection activities focused on the dynamic nature of landowners and their relationships with local social and ecological networks. Such relationships, we argue, have the potential to create property and landscape-level change with important implications for the management of wildlife and wildlife corridors.

Reduced speed limit: an effective way to reduce wildlife-vehicle collisions?

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ABSTRACT: Every year wild ungulates in the GYE make migrations spanning tens to hundreds of miles. This behavior is essential to maintaining the abundance and health of the GYE's deer, pronghorn, elk and moose. Migratory ungulates must cross a matrix of highways to reach the resources they need. Wildlife-vehicle collisions (WVCs) on these roads are a significant source of wildlife mortalities, and traffic on roads creates a partial to complete barrier to wildlife movement paths. Wildlife crossing structures can reduce WVCs by ~90% and greatly improve habitat connectivity. However, these structures are expensive and, in some cases, impractical

— prompting transportation managers to seek alternatives. Among the general public, there is support for reducing speed limits in WVC hotspots. However, almost no research exists on the effectiveness of reducing speed limits as a way to reduce WVCs, and studies of driver behavior suggest that reducing the posted speed limit may not slow drivers down. In order to inform this debate and future management practices, we are working with the Wyoming Department of Transportation (WYDOT) to assess the effectiveness of reduced nighttime speed limits in six WVC hotspots in the southern GYE. In each location, WYDOT reduced the posted speed limit from 70 mph to 55 mph at night during peak WVC seasons. Using a BACI design, we measured the effects of these speed limit reductions on vehicle speeds and traffic dynamics using radar recorders; deer road-crossing behavior using infrared video cameras; and deer-vehicle collision rates using carcass counts. Our preliminary results indicate that drivers reduce their speed by 3-5 mph in response to the 15 mph reduction in speed limit, which may not be sufficient to alter WVC rates. This study is unique in scope and will be important in determining whether reduced speed limits are adopted more widely in the GYE.

Nature Mapping Jackson Hole: Mapping Community Solutions

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ABSTRACT: Jackson Hole Wildlife Foundation's program Nature Mapping Jackson Hole (NMJH) engages almost 500 volunteer citizen scientists whose recorded wildlife observations of all local species (except insects) create a valuable long-term dataset of presence and movement. NMJH strives to fulfill wildlife observation and distribution needs not already covered by state and federal agencies or local research organizations, and to provide migration data that highlight corridors in need of fence-removal or other improvements to JHWF programs like Wildlife Friendlier Fencing.

Certified Nature Mappers (i.e., those who have successfully completed a two-hour training session) enter their wildlife observations into a JHWF central database specific to the program.

<u>Nature Mapping Jackson Hole Goals:</u>

- Keeping common species common (studying all species, not just high-profile species or species of concern)
- Increasing citizen knowledge of and appreciation for wildlife in Teton County, WY
- Engaging citizens in long-term wildlife data collection
- Informing management decisions that favor migratory connectivity and general wildlife sustainability

- Contribute data to the Wyoming Game & Fish Department's Wildlife Observation System (WOS) to augment state data.

Elk south of Yellowstone migrate early at cost of reduced forage

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ABSTRACT: Migration allows individuals to strike a balance between risk and reward, and use resources in the places and at times that maximize fitness. Large ungulates commonly migrate to increase access to quality forage in spring and decrease risks associated with winter weather in the fall in an effort to maintain the body condition necessary for winter survival and successful reproduction. However, foraging exists within a realm of strategies employed to maximize fitness, and so animals must take factors like safety into account when choosing to migrate. Here, we use 5 years of data from 73 female elk (*Cervus canadensis*), most of which are part of a subgroup of elk that utilize a protected area during hunting season, to identify the driving factors behind the initiation of migration from their late summer range. The onset of archery season, remotely sensed vegetation degradation, and having access to lands where hunting was prohibited (Fossil Butte National Monument) initiated autumn migration, with bad weather having a smaller effect. 67% of elk using the Monument initiated migration prior to the onset of archery hunting season (1 September), preemptively avoiding risk, while no elk from the subgroup not using the Monument left prior to archery season, despite spending summer at higher elevations. Departure from productive summer range nearly two months before vegetation senescence afforded protection on the Monument during hunting season, but decreased access to late summer-fall forage (integrated NDVI) by 21%. Our results illustrate the complexity of managing a wide-ranging ungulate across jurisdictions with multiple missions. We will illustrate the migration corridors and an infographic illustrating drivers of elk migration.

Potential movement paths for male-mediated gene flow to and from an isolated grizzly bear population

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

Peck, C. P., F. T. van Manen, C. M. Costello, M. A. Haroldson, L. A. Landendurger, L. L. Roberts, D. D. Bjornlie, and R. D. Mace. 2017. Potential movement paths for male-mediated gene flow to and from an isolated grizzly bear population. Ecoshpere 8(10):e01969.

Sagebrush Removal Alters Vegetation Dynamics for Migrating Ungulates

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ABSTRACT: Over the past century, sagebrush-reduction treatments have been applied widely throughout western North America to increase herbaceous vegetation for livestock and wildlife, including migrating ungulates in the Greater Yellowstone Ecosystem. Many ungulate species track plant phenology during spring migration, and this relationship has been modeled effectively with the instantaneous rate of green-up, a metric of phenology derived from satellite imagery. We used indices from satellite imagery that are relevant to ungulate migration to 1) quantify effects of prescribed-fire, herbicide, and mechanical treatments on vegetative cover, productivity, and phenology, and 2) describe how vegetation changed over

time following these treatments in the Upper Green River Valley. We hypothesized that treatments would increase herbaceous cover and accordingly shift phenologies towards those typical of grass-dominated systems. We expected prescribed burns would lead to the greatest and most-prolonged effects on vegetative cover and phenology, followed by herbicide and mechanical treatments. Treatments appeared to increase herbaceous cover and productivity, which coincided with signs of earlier senescence − signals expected of grass-dominated systems, relative to sagebrush-dominated systems. Spatial heterogeneity for most phenometrics was lower in treated areas relative to controls, which suggested treatment-induced homogenization of vegetative communities. Phenometrics that explain spring migrations of ungulates mostly were unaffected by sagebrush treatments. Fire had the strongest effect on vegetative cover, and yielded the least evidence for sagebrush recovery. Overall, treatment effects were small relative to those reported from field-based studies for reasons most likely related to sagebrush recovery, treatment specification, and untreated patches within mosaicked treatment applications. Treatment effects were also small relative to inter-annual variation in phenology and productivity that was explained by temperature, snowpack, and growing-season precipitation. Our results indicated that cumulative NDVI, late-season phenometrics, and spatial heterogeneity of several phenometrics may serve as useful indicators of vegetative change in sagebrush ecosystems.

Characterizing the Seasonal Movements of Native and Restored Bighorn Sheep: A Case for Conserving Migratory Portfolios

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ABSTRACT: Animal migrations represent the culmination of a long evolutionary history resulting in genetic, physiological, behavioral, and life-history traits that facilitate the successful interaction between individuals and biotic and abiotic factors in their environment. Once lost, attempts to restore migration generally result in diminished seasonal movements compared to historic migratory patterns. Over their broad distribution, bighorn sheep show diverse seasonal movements from resident to long-distant migrants spanning varied elevational and geographic gradients, yet much of our current understating of bighorn sheep movements stems from periodic tracking of animals instrumented with VHF collars sampled from single populations. While restoration efforts (i.e. translocations) have undoubtedly resulted in modest successes, bighorn sheep occupy only a small fraction of their former range and predominantly occur in restored populations that number fewer than 100 individuals. Although factors related to disease, competition, and habitat quality routinely inform bighorn sheep translocations, less attention has been given to seasonal movements, yet the tendency to migrate has been

positively associated with translocation success. As an initial step to exploring the importance of migrations in bighorn sheep restoration, we used GPS location data to characterize the seasonal movements of over 200 female bighorn sheep across four states. Specifically, we evaluated the presence and diversity of migratory movements between restored and native herds. We report findings from this large-scale comparative analysis spanning herds with varied demographic performance and management histories, and propose stronger consideration of seasonal movements as an important component of future bighorn sheep restoration.

Migratory flexibility suggest facultative switching in a partially migratory elk herd.

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ABSTRACT: Migration is a behavioral strategy used to maximize fitness in environments where resources and predation vary spatially and temporally on the landscape. To maintain partially migratory populations, we assume fitness is balanced between migrant and resident strategies. In the longest continuous study of wild elk in North America, we have studied the partially migratory behavior of the Ya Ha Tinda elk herd in AB, Canada, which over the past decades has experienced declines in both population size and shifts in migratory routes. Migrants access higher quality forage predicted by dynamic forage models which is corroborated by higher fecal Nitrogen. This corresponds to higher pregnancy rates, larger calf body mass, or cow: calf ratios in migratory individuals. Resource selection studies reveal that migrant elk experience lower predation risk on the summer range, but experience higher predation risk during migration. The higher quality forage translates into higher demographic fitness for migrants only where predation risk is lower. Therefore, elk balance the trade-offs in predation risk and forage quality. However, the population had an average annual switching rate of 15% per year between migratory strategies in 2002-2010, which may had led to the 3%/year decline in population. During the past 5 years an increase in elk migrating earlier to low elevation, industrial forests that green-up earlier and have lower predation may be stabilizing the herd a new low equilibrium. Our long-term study of migration in this transboundary system reveals unexpected flexibility and dynamics over decadal time scales related to changing benefits and risks of migration.

Natal origins of army cutworm moths (*Euxoa auxiliaris*) in the Absaroka Mountains, Wyoming

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ABSTRACT: The army cutworm moth (*Euxoa auxiliaris*) is a seasonal migrant to the Greater Yellowstone Ecosystem. It is an important grizzly bear (*Ursus arctos horribilis*) food at high elevations in the summer and a pest in pre-migration habitat in agricultural regions throughout the Great Plains and Intermountain West. Currently, we do not know where our seasonal populations are migrating from which is critical to predict population fluctuations and annual availability as a key grizzly bear food, and to establish effective management plans. The objective of our study is to estimate the natal origins of army cutworm moths in the Absaroka Mountains, Wyoming. We will analyze naturally occurring stable-hydrogen isotopes found in inert wing tissues of moths collected at low and high elevations and estimate natal origins by linking our analysis to a tissue-specific 'isoscape'. Moth samples were collected from two sites summer 2017 in the Absaroka Mountains and will be collected again summer 2018. We have recruited 25 volunteers from 10 states and 2 Canadian provinces to help collect moth samples spring 2018 in agricultural areas. We hope that stable isotope analysis techniques will allow us to estimate the origins of army cutworm moths to inform management in the Greater Yellowstone Ecosystem.

Elk migration as an ecosystem service by reducing the risk of brucellosis transmission to livestock

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ABSTRACT: The migration of elk in the spring coincides with the period of greatest transmission risk for brucellosis, a bacterial disease of significant management concern because of the risk of spillover from elk to livestock. To evaluate the dynamic interplay between elk migration and disease spillover, we employed an integrated modeling approach using telemetry data from 223 female elk. We predicted brucellosis-induced abortion events for migrant and resident elk from eight herds on a daily basis by combining estimates of elk occurrence, elk abortion rates, elk seroprevalence, livestock distribution, and herd population counts. As anticipated, weather variability affected the distribution of migrant risk, with a 7-12% increase in migrant abortions occurring on private grazing lands during years with heavier snowfall. Migrants were responsible for the majority of abortions (~73%) because of their greater numbers. On a per-capita basis, however, residents disproportionately contributed to abortions on private grazing

land. Our results can be used to focus disease management efforts on areas with the highest risk of brucellosis transmission in space and time, and demonstrate that migrations provide an ecosystem service by reducing the risk of brucellosis transmission to livestock.

Roads as barriers to ungulate migrations: traffic thresholds in highway permeability

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ABSTRACT: Roads pose a significant threat to ungulates and other wildlife. Roads can be formidable barriers to animal movements and habitat connectivity, particularly for long-distance migrants, and they are a source of numerous animal mortalities. In the GYE, growing concerns about roads are spurring efforts to mitigate their impacts. Wildlife crossing structures are highly effective but costly solutions. We are using novel approaches to prioritize locations where crossing structures are most needed to restore habitat connectivity for ungulates. Although higher traffic volumes are generally thought to increase the barrier effect of roads, there are currently no guidelines about what traffic volume constitutes a challenge to ungulate movements. To address this, we installed thermal video recording systems on eight stretches of highway in the southern and eastern GYE and captured 1,357 mule deer attempts to cross these highways. We measured instantaneous traffic volumes and the duration of gaps between consecutive vehicles and scored deer road crossing success or failure for each gap and each overall attempt to cross. We also scored any collisions or narrowly avoided collisions. Using logistic regressions, we show strong threshold dynamics in gap duration and traffic volume between failed, risky, and safe deer road crossings. We found that deer need about 60 seconds between consecutive vehicles in order to consistently, safely cross roads. By combining this with spatio-temporal patterns in traffic and our previous work to identify hotspots of collisions in Wyoming, we show which roads present the greatest barrier to habitat connectivity for deer. In doing so, we can show where crossing structures are most needed to ensure deer habitat connectivity and protect long-distance migration corridors. These approaches shed new light on how to reduce the barrier effects of roads most cost-effectively and can be applied to other species and locations throughout the GYE and the West.

Wild Migrations: A Comprehensive Atlas Visualizing the Science and Conservation of Ungulate Migrations

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ABSTRACT: The Wyoming Migration Initiative (WMI) has developed an Atlas of ungulate migrations. The foundation of the atlas is an extensive collection of data driven thematic maps and graphics contributed by numerous scientists and managers in Wyoming. As GPS-collar technology improves, wildlife ecologists are collecting immense amounts of location and time-stamped data, revealing unprecedented insight into ungulate migration. Through the synthesis of data and the design of maps and graphics, "Wild Migrations" visualizes the complexity of ungulate migration ecology with the goal of advancing understanding and conservation of Wyoming's ungulate migrations and the landscapes they depend on. "Wild Migrations" covers the ecology and history of migration in addition to the current threats these journeys face and some of the innovative approaches being pioneered to conserve migration corridors. Topics highlighted include migration corridor assessment, stopovers, bottlenecks, and more.

The Atlas foreword was contributed by Annie Proulx and contains beautiful photos of Joe Riis and Mark Gocke. The Atlas tells the stories of ungulate migration with visually stunning maps and figures. The Poster outlines the collaborative process used to develop the Atlas and presents examples of page pairs and reviews the content of the Atlas.

This atlas project is a collaborative effort among cartographers from the University of Oregon and wildlife biologists from the University of Wyoming and the Wyoming Migration Initiative. Wild Migrations publisher is Oregon State University Press.

Spatial ecology and conservation of long-distance mule deer migrations from Grand Teton National Park

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ABSTRACT: Although the Greater Yellowstone Ecosystem (GYE) hosts several of the longest ungulate migrations remaining in the contiguous United States, expanding development and an increasing human footprint continue to truncate migratory routes. While some migrations begin at seasonal ranges on protected lands, migration corridors frequently cross or end within other jurisdictional boundaries, including large tracts of private or multiple-use lands, with varying levels of protection. Understanding migratory behaviors as well as identifying vital habitats and potential barriers to continued movement enhances conservation planning efforts aimed at protecting wildlife populations dependent on a migratory strategy to survive. Recent research has revealed that Grand Teton National Park (GTNP) is at the center of a network of mule deer (*Odocoileus hemionus*) migration routes radiating outward in all directions. This

migratory network connects summer ranges within the park with wintering areas throughout the GYE. Using GPS collar location data from adult female mule deer (n=26), we delineated migration corridors using the dynamic Brownian Bridge movement model. We then compared the spatial characteristics (e.g. elevational gradient, land jurisdiction, land cover, and road density) present within each corridor. Preliminary analyses have led to identification of six migratory corridors, each with a diverse set of spatial traits. Several of the routes traversed elevations greater than 10,000 feet, and southern aspects dominated most corridors. Five of the routes included private lands, and most crossed a minimum of three jurisdictional boundaries. While several corridors spanned roadless wilderness areas, two of the routes crossed major highways at least once. We also identified several areas of interest, including a location where multiple migration routes merge east of GTNP, major stopover sites on private lands, and several roadway crossings, as future research needs. Our results contribute to an enriched understanding of mule deer migrations in the GYE to support long-term conservation efforts.

Agency Partnerships: Collaborating for Wildlife, Safety, and Economic Opportunity on the Yellowstone Highway

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ABSTRACT: The Idaho Department of Fish and Game (IDFG) and the Idaho Transportation Department (ITD), under the guidance of a Memorandum of Understanding and a Cooperative Agreement, are providing information and recommendations regarding how state and federal highways and concomitant traffic may be managed to reduce impacts to motorists and wildlife populations. These agencies work together to reduce wildlife-vehicle collisions (WVCs), improve safety and mobility and increase permeability of roads for wildlife. This provides congruity between agency missions on matters of safety, economic growth and environmental stewardship. An ITD project on US 20 in Island Park near Targhee Pass has provided an opportunity to address wildlife concerns while improving motorist safety and mobility. Notable long-distance ungulate migrations occur twice yearly through this four-mile stretch of highway. Grizzly bears, wolverine and moose cross the road as part of daily movements. The project's Purpose and Need includes goals to reduce WVCs and enhance wildlife movement across US 20. Highway improvements include widening the road shoulders and adding a truck-climbing lane. Alternatives for the Environmental Assessment (EA) include three of five scenarios that describe highway design elements proven to reduce WVCs. Two alternatives will increase landscape permeability for wildlife. Through the scoping process, local government and residents have raised concerns about use of tax dollars, highway treatments to provide for

wildlife movement that could lead to closure of public land, view shed impacts and compromised property values. Despite public meetings, website information and regular stakeholder outreach, misrepresentations and confusion persisted about what was proposed and what the effects might be. The Idaho Transportation Department expects to announce a Preferred Alternative in June 2018. We will discuss proposed alternatives, the outcome of the project, challenges, lessons learned, and goals moving forward.

Tracking Greater Sage-grouse migration and identifying wintering origin by combining radio-telemetry and stable isotopes

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ABSTRACT: Much of Greater Sage-grouse conservation is focused on improving habitat around lekking areas, but distant wintering habitat may contribute equally to the viability of populations, a pattern that has been shown with other avian taxa. On-going research in the Centennial Valley in southwestern Montana has tracked 182 female Sage-grouse year-round for 3 years with VHF radio-telemetry collars. Based on this work, we have observed individuals moving as little as 0.73 km or as far as 79.2 km from their lek to wintering grounds (mean distance = 23.8 km). Some of these individuals also exhibit high fidelity to wintering sites across years. Our research aims to better understand migration patterns and the importance of wintering grounds on life history of Greater Sage-grouse. We will identify wintering origin of individual females using radio telemetry and stable isotope techniques and assess the influence of wintering grounds on reproductive success (i.e., breeding propensity, nest and brood success). Our findings will help managers identify seasonal habitats contributing to reproductive success, which are areas critical to Sage-grouse conservation that may have been previously overlooked. These techniques also could be effective in other regions with migratory populations of Sage-grouse.