



Wyoming Range Mule Deer Project Winter 2018-19 Update



MONTEITH SHOP

HAUB SCHOOL OF ENVIRONMENT
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WYOMING RANGE MULE DEER PROJECT

Project Background

In recent decades, mule deer abundance throughout the West has struggled to reach historic numbers, and Wyoming is no exception to the nearly ubiquitous trend of population declines. In response to concerns of mule deer populations in Wyoming, in 2007, the Wyoming Game and Fish Commission adopted the *Wyoming Mule Deer Initiative* (MDI) with the intent to develop individual management plans for key populations. Of particular concern was the Wyoming Range mule deer population in western Wyoming—one of the largest mule deer herds in the state and a premier destination for mule deer hunting in the country. The Wyoming Range mule deer population has undergone dynamic changes in recent decades from a population high of >50,000 in the late 1980s, to a sustained population of ~30,000 during much of the last decade (Fig. 1). Consequently, the Wyoming Range mule deer population was identified as a top priority for the development of a management plan according to the MDI. The first of the population-specific management plans, the *Wyoming Range Mule Deer Initiative* (WRMDI), was finalized in 2011 following a collaborative public input process. To direct development of an effective management plan, it was recognized by the Mule Deer Working Group (2007) that the “*Success and implementation of these plans will depend upon our ability to identify limiting factors to mule deer populations and their habitats*”. Accordingly, the Wyoming Range Mule Deer Project was initiated 2013 to address the need for research in identifying the factors that regulate the Wyoming Range mule deer population.

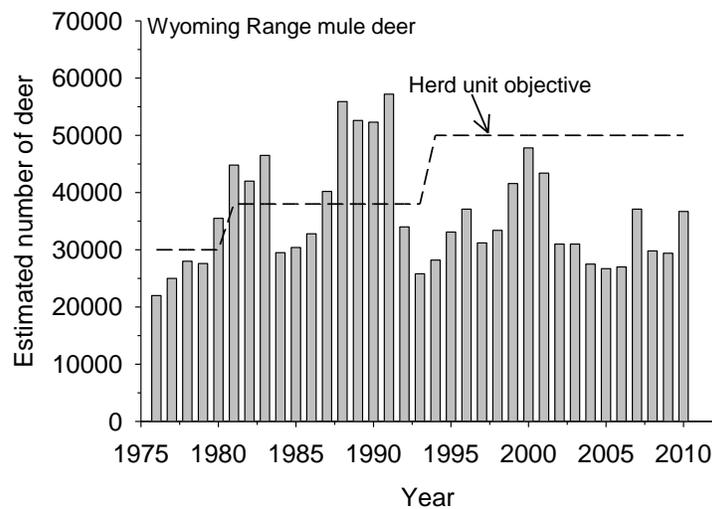


Figure 1. Estimated population size of the Wyoming Range mule deer herd relative to herd unit objective, 1976-2010.

The overarching goal of the Wyoming Range Mule Deer Project is to investigate the nutritional relationships among habitat conditions, climate, and behavior to understand how these factors interact to regulate population performance. We initiated the project in March 2013 with the capture of 70 adult, female mule deer on two discrete winter ranges for migratory, Wyoming Range mule deer (Fig. 2). In summer 2015, we initiated Phase II of the Wyoming Range Mule Deer Project that focuses on survival and cause-specific mortality of neonate mule deer. In the fall of

2018, we began Phase III of the project, which is focused on the recovery of the population following the severe winter of 2016-17 in the Wyoming Range that resulted in almost complete removal of a cohort from the population and high adult mortality. Since the initiation of the project, we have tracked and monitored the survival, behaviors, reproduction, and habitat conditions of 202 adult female and 277 juvenile mule deer of the Wyoming Range. This update highlights some of our many discoveries on mule deer ecology since the initiation of the project.

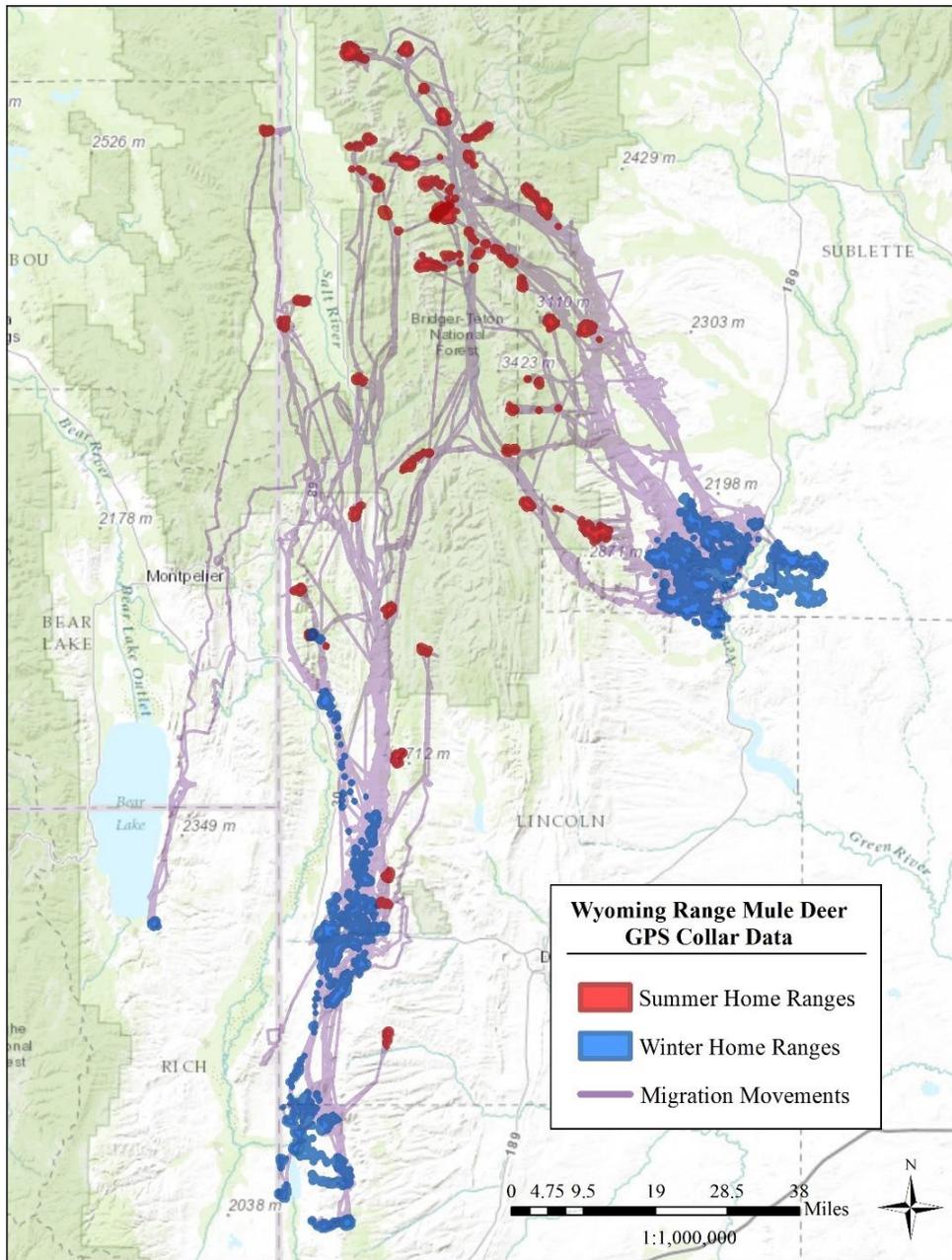


Figure 2. Winter and summer home ranges (based on 95% Kernel Utilization Distribution of GPS collar data) as well as migration movements of Wyoming Range mule deer.

The Wyoming Range Mule Deer Project

Using a nutritional ecology framework, we aim to evaluate how conditions of seasonal ranges mule deer encounter throughout the year—ranges used during summer, winter, and migration—affect individual animals. Using this unique approach, we aim to develop a comprehensive understanding of how the connections individual deer have with their environments influences population dynamics.

Adult Captures

Since March 2013, we have captured and recaptured 202 adult, female mule deer. Upon each capture, in addition to fitting each animal with a GPS collar, we collect a suite of data on each animal including age, nutritional condition, morphometry, pregnancy, and fetal rates. Animals are recaptured each spring (in March) and autumn (in December) to monitor longitudinal changes in nutritional condition and reproduction. In doing this, we can link various life-history characteristics with behaviors and habitat conditions of individual animals.

At each capture event, we use ultrasonography to measure fat reserves (i.e., % body fat). By recapturing collared mule deer and measuring body fat each autumn and spring, we are able to track changes in nutritional condition between summer and winter seasons.

Although most animals lost fat in the winter and gained fat in the summer, the rate at which fat reserves increased or decreased varied widely among individual animals. A suite of factors can influence fat dynamics between winter and summer seasons, but availability of food on seasonal ranges and number of fawns a female raises have the greatest effect on fat dynamics.



Reproductive success of individual animals greatly influences population dynamics; therefore, we closely monitor pregnancy and recruitment of young for each of our study animals. We use ultrasonography to monitor pregnancy rates of our study animals during spring capture events. Each autumn, as animals arrive to winter range, we evaluate fall recruitment using on-the-ground observations of the number of fawns at heel of our collared adults.

Neonate Captures

In March 2015, we initiated Phase II of the Wyoming Range Mule Deer Project by recapturing collared deer and deploying a vaginal implant transmitter (VIT) in pregnant females. VITs were used to indicate where and when birth occurred. Once birth events were identified, we captured and collared fawns born to our collared females as well as fawns that were found opportunistically throughout the Wyoming Range. Since 2015, we have successfully tracked 277 fawns and have been continually monitoring their survival.



When a mortality was detected, we immediately investigated the event to ensure an accurate assessment of the cause of mortality. We have detected a breadth of various causes for fawn mortality including predation, disease, malnutrition, drowning, hypothermia, vehicle-collision, and just being caught in vegetation.

In 2015, disease was the leading cause of death for collared fawns and accounted for 28% of all mortalities. The most prevalent disease, adenovirus hemorrhagic disease (AHD), is a viral disease that can cause internal hemorrhaging and pulmonary edema. In 2017, 26% of fawn mortalities were the result of stillborns. Conversely, in 2018, only 1 of the 83 fawns collared was stillborn. We are still waiting on results from the Wyoming State Vet Lab to determine the leading cause of death for fawns in the summer of 2018.

	2015	2016	2017	2018
Number of Fawns Tracked	58	70	67	83
Median Birthdate	June 10	June 13	June 17	June 11
Average Birthweight	7.9 lb	7.5 lb	6.7 lb	7.6 lb
Summer Mortality	45%	56%	52%	49%
Winter Mortality	9%	44%	7%	3%*
Total Mortality	54%	100%	59%	NA

Summer mortality is based on survival until October 31st in the year a fawn was born. Winter mortality is based on survival from November 1st to April 30th.

** Winter mortality as of 7 January 2019*

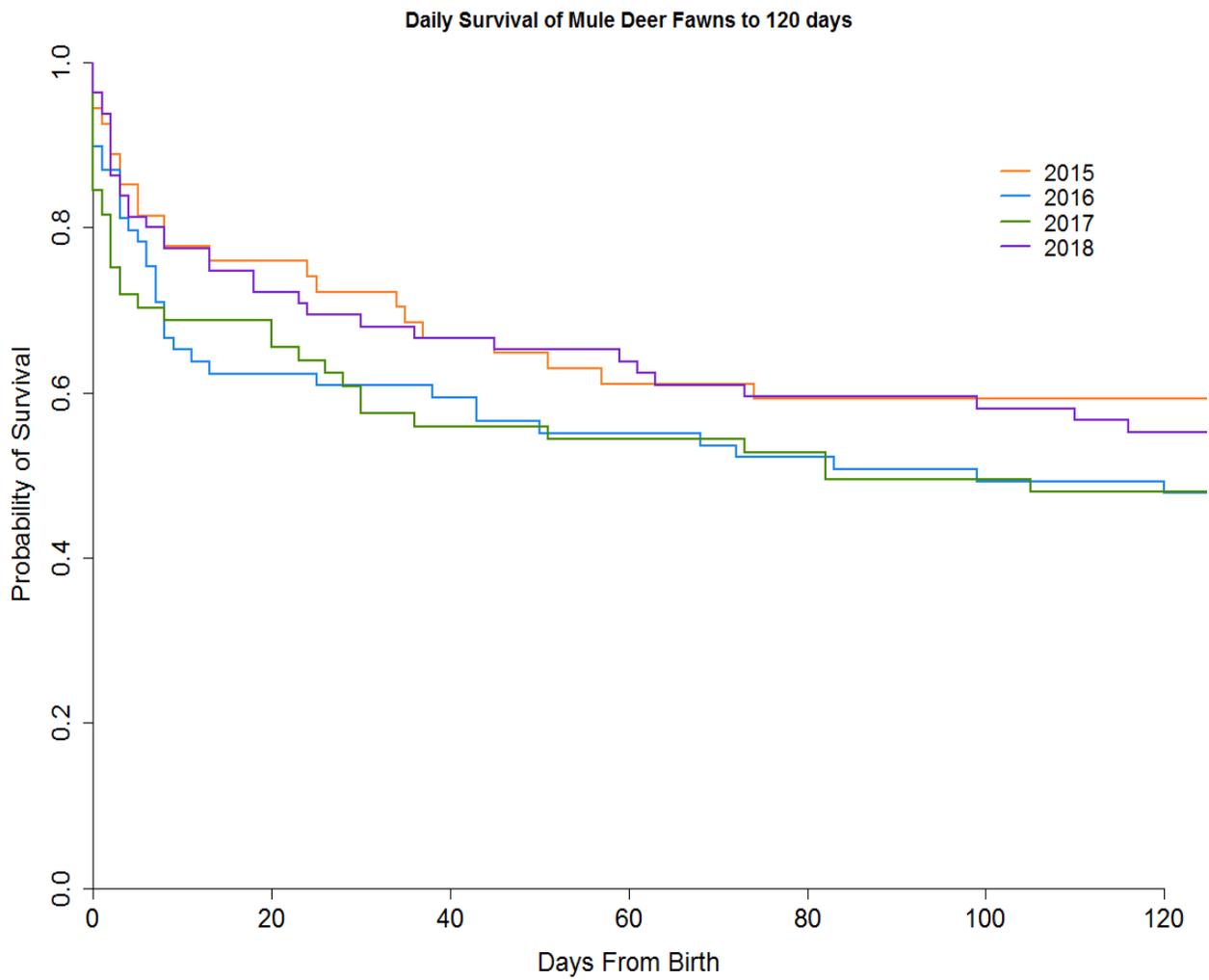
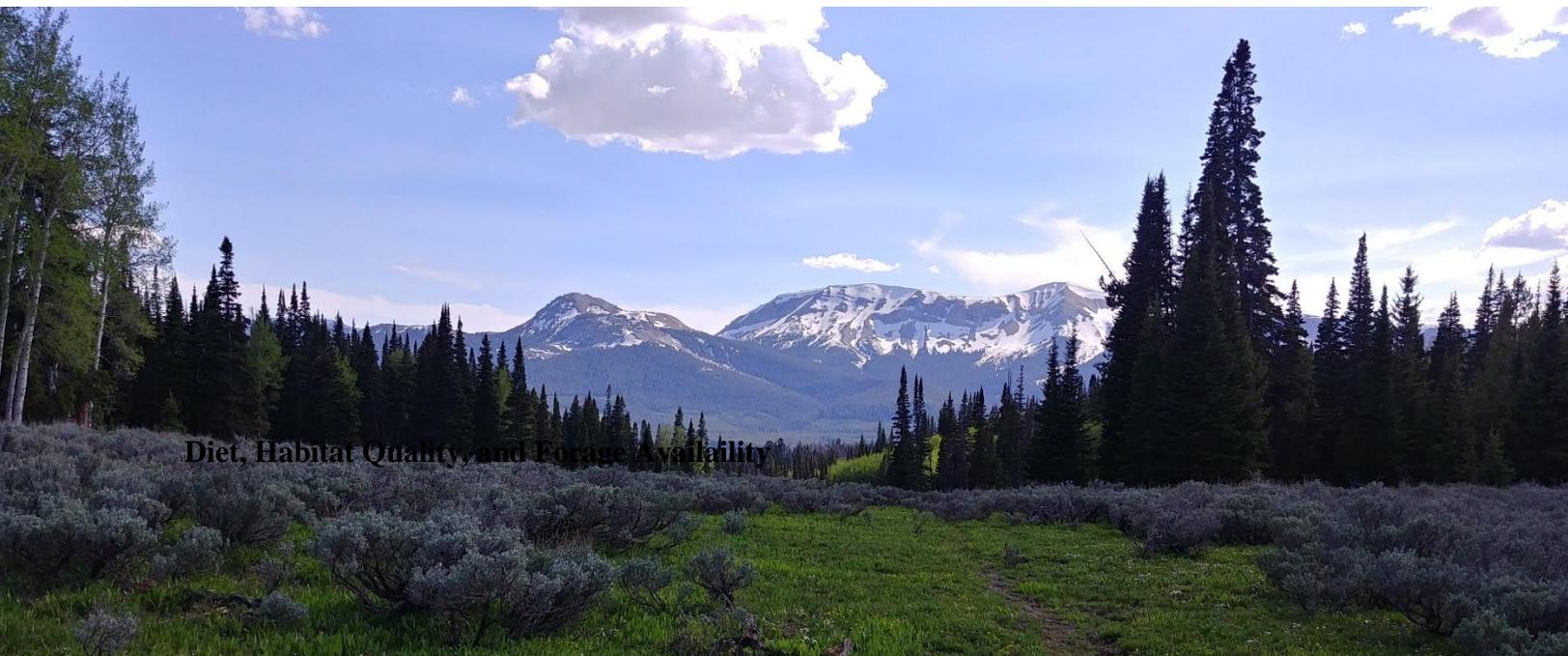


Figure 3. Probability of survival of neonatal mule deer in the Wyoming Range from birth up to 120 days in each summer from 2015 to 2018.



Diet, Habitat Quality, and Forage Availability

The condition of a female and the habitat conditions she experiences in the summer may be very important in predicting and understanding fawn survival—especially in understanding the relative contributions of nutrition and disease to vulnerability to mortality. Therefore, we are coupling data on summer habitat conditions with information on maternal condition (i.e., nutritional condition) to evaluate how it influences fawn survival.

In 2013 and 2014, we evaluated the quality and availability of plants within the diets of Wyoming Range mule deer during summer. To assess mule deer diets, we collected fecal samples from summer home ranges of collared deer and used microhistology and DNA metabarcoding to identify plant species within their diets in summer 2013 and 2014. Based on frequency of plants within mule deer diets, we then collected plant clippings that we analyzed for quality (e.g., crude protein and digestibility). We began collecting fecal samples from summer home ranges again in the summer of 2018.



In addition to assessing quality and diet composition, we have been evaluating key species of forage in summer home ranges of collared females at known locations during different periods of reproduction (i.e., partition and peak lactation) since the summer of 2015.



Ecology of Spring Migration

At the largest spatial scale, migration is recognized as a strategy that allows migrants to exploit high-quality resources available on one seasonal range, while avoiding resource deficiencies on the other. Much less is known, however, about the fine scale movement behaviors that animals make during migration. This portion of the Wyoming Range Mule Deer Project aims to understand the importance of food resources available during migration, and how the habitat quality of migratory routes influences survival and reproduction of migratory mule deer in the Wyoming Range.

Spring migration is a critical time for migrants, in which they must recover from harsh winter conditions and prepare for upcoming reproductive costs. It is hypothesized that movement from low elevation winter ranges to high elevation summer ranges, allows migrants to extend the amount of time they are exposed to young, highly palatable forage. Following a wave of newly emergent, high-quality forage along elevational gradients, is known as “surfing the green wave”. This project will investigate the role of the migratory route as critical habitat, with the aim to better understand the importance of migration as well as to inform management strategies to protect migration in the Wyoming Range and beyond.

Project Objectives

1. Test the green wave hypothesis in migratory mule deer and explore the source of individual variability in green-wave surfing (Completed, see below).
2. Investigate the influence of drought on green-wave surfing (In progress).
3. Understand the relative importance of green-wave surfing to fitness (In progress).



Testing the Green Wave Hypothesis

Deer should select plants that are at intermediate growth stages (i.e. not too old or not too young) because plants which are greening up are both easy to digest and available in large enough quantities to maximize energetic gains. If deer surf a wave of plant green-up, then the timing of their movements during spring migration should be perfectly matched with the timing of peak green-up in plants. When we tested this prediction, this is indeed what we found (Figure 3). We noticed, however, that there was a lot of variability in the green-wave surfing ability of individuals. To further investigate the source of this difference in green-wave surfing we considered how the progression of the green-wave across individual routes may differ. We found that some routes had long, easy to follow gradients in plant green-up, while other routes had short, rapid and difficult to follow gradients in plant green-up. Together this difference in the amount of time when green-up was available along a migration route (i.e. the green-up duration) and the gradient of green-up from winter range to summer range (i.e. the order of green-up), which we refer to as the “greenscape”, largely explained the differences in green-wave surfing across individual deer using different migration routes.

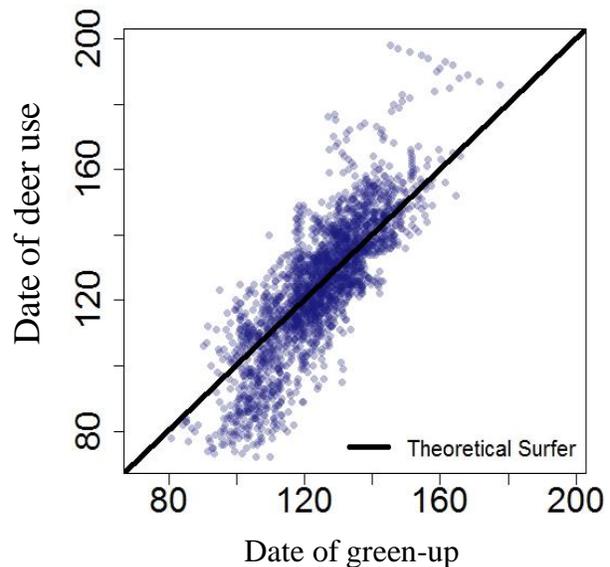


Figure 3. Evidence for green-wave surfing by mule deer in the Wyoming Range. The black line represents the theoretical prediction of a perfect match between the date of green-up and the date of deer use. Data points fall close to this line, suggesting that in general deer are surfing the green wave.

What have we learned?

- Green wave surfing is key to the foraging benefit of migration.
- The migration route provides critical habitat.
- Timing is key, thus activities that may alter the ability of deer to exploit the green wave should be avoided or minimized during the spring migration period.
- The greenscape (i.e. the duration and order of green-up along a migration route) determines the quality of a route.

This research is published! For more information, see:

Aikens, E.O., M. J. Kauffman, J. A. Merkle, S. P. H. Dwinell, G. L. Fralick, and K. L. Monteith. 2017. The greenscape shapes surfing of resource waves in a large migratory herbivore. *Ecology Letters* 20:741-750.

Evaluating the ontogeny of ungulate migration

Each year, millions of animals migrate between distinct portions of their home ranges. This behavior allows animals to increase fitness by prolonging or increasing access to high-quality resources and at times reducing predation risk. Through both their seasonal ranges and migratory routes, animals can access markedly more resources without diminishing them because of their diffuse presence on a landscape, potentially bolstering carrying capacity and promoting larger populations of migratory animals than non-migratory animals. Despite its central role in a variety of ecological processes, we lack a mechanistic understanding of how these behaviors originate and are maintained.

In ungulates, migration is thought to be maintained via cultural inheritance. Mule deer, for example, are a social species that exhibit maternal care for the first year of life, which may allow for the cultural transmission of migratory information if offspring migrate with their mother for their first migration. Additionally, mule deer are faithful to their migratory routes and seasonal ranges. Whereas fidelity might boost familiarity or indicate strategies that have already been successful, rigidity that may have ensured success in the past may challenge persistence in a changing world.



Figure 1. Year-round GPS points of F014 (2 years old) and her mother, 108.

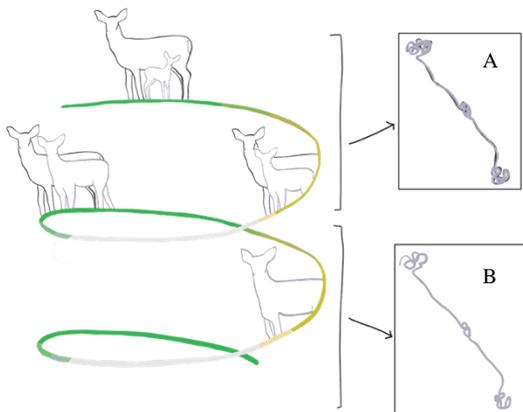
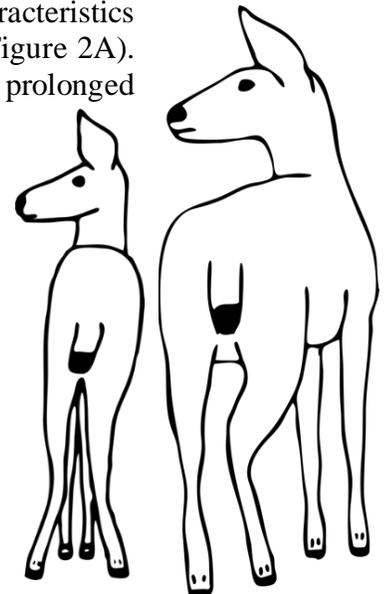


Figure 2. Fawns (purple) live with through at least their first fall (right side of spiral) and spring (left side of spiral) migrations. Fawn and mother's migrations should overlap considerably during the first year of life (A). If migration is culturally inherited from mother during the first year of life, fawn will migrate similarly to their mother, even after maternal investment has ended (B).

have been fitted with GPS collars. Through understanding how migration originates, we will gain a deeper understanding of how to protect migratory behaviors into the future.

Despite mounting evidence for the cultural inheritance of migratory behaviors and its potential ramifications for populations, we still lack a mechanistic understanding of how migratory behaviors are maintained in a population, and the degree to which this mechanism is flexible. To that end, we are working to identify the mechanism underpinning migration in mule deer. We hypothesize that an individual's migratory characteristics are inherited from their mother (Figure 2A). Additionally, we hypothesize that prolonged maternal investment will facilitate the cultural transmission of migratory behaviors (Figure 2B) by establishing patterns that are followed into adulthood.

Using the Wyoming Range Mule Deer project as a study system, we will evaluate these hypotheses using mother-daughter pairs that



Assessing public beliefs of ecological concepts regarding mule deer management

Communication with the public makes up an increasing proportion of wildlife management and research. As reflected by the North American Model of Wildlife Conservation, wildlife are a public resource; communicating with stakeholders therefore is part of wildlife professionals' ethical obligation to ensure that the public is informed and has a voice regarding wildlife-related actions. Although communication is an integral part of any wildlife professional's job, many struggle to effectively communicating with the public, in large part because we still lack fundamental understandings of the public.



When wildlife professionals communicate information to members of the public, this message must navigate through a variety of cognitive levels to be absorbed by an individual. Wildlife value orientations provide a useful framework for relating how fundamental aspects of an individual, such as their values and beliefs, will shape their engagement with a variety of wildlife issues through their attitudes and behaviors. Despite the utility of wildlife value orientations as a framework, the explicit roles of beliefs in shaping attitudes and behaviors are often overlooked in wildlife-related issues. Beliefs can shift through time as an individual learns additional information and incorporates it into their belief structure. Therefore, assessing wildlife-related beliefs among members of the public and identifying mismatches with scientific facts could assist in promoting effective communication of wildlife-related issues.



Although all wildlife-related issues likely have potential for mismatch between individual beliefs and knowledge gained via science, management issues concerning ungulates frequently create division among members of the public and wildlife professionals or within sections of the public. Mule deer, for example, are a popular game species in the western United States, but population numbers are declining or stagnant throughout most of their range. In Wyoming in 2017, resident and non-



resident hunters purchased 69,558 licenses and provide a substantial amount revenue to the state wildlife agency (Wyoming Game and Fish Department 2017). Because of the substantial public interest in big game management, wildlife professionals frequently communicate with the public regarding management decisions. It is often unclear, however, whether these messages are constructed and delivered in a way that is poised to be understood by the public.

To aid in improving communication efforts between wildlife managers and the public, we are beginning a study to identify mismatches between information held by citizens of Wyoming who are invested in Wyoming's mule deer populations and knowledge generated by the scientific community related to mule deer management. We aim to work collaboratively with Wyoming Game and Fish Department, non-profits, NGOs, and individual stakeholders to broadly deliver a survey assessing the public's values and beliefs regarding mule deer management. Through these surveys, we aim for this information to provide specific ways for wildlife professionals to improve communication efforts with members of the public.

Assessing Carryover Effects of a Severe Winter

The winter of 2016-17 proved to be tough on mule deer in the Wyoming Range. Conditions on winter ranges for Wyoming Range mule deer were severe with snowpack levels exceeding 200% and numerous days of sub-zero weather. These harsh winter conditions strongly affected winter survival and only 63% of our collared adults survived from November until summer 2017 (compared with >90% in years past). For adults, survival was dependent on both age and condition; older animals and animals that entered winter in poor condition were more susceptible to succumbing to winter exposure than young or fat individuals.



Furthermore, we saw a dramatic effect of the harsh winter on survival of fawns. Winter conditions tend to have the greatest effect on survival of fawns, and the 2016-17 winter was no exception. We observed 100% mortality of the radiocollared fawns that entered the winter. Mortality rates of that caliber can have substantial repercussions on population dynamics because the majority of an entire cohort of deer is gone. Although these numbers are staggering, winter die-offs, as the one observed this winter, do occasionally occur and populations do eventually rebound. We have now found ourselves with a unique opportunity to evaluate how mule deer populations rebound from harsh winters.

Nutritional condition in March 2017, measured as % body fat, was the lowest we have observed in our research (2.3% in 2017 compared with 4.0–5.3% in 2013–2016). Although it is rare to see animals in this poor of condition, it was surely a product of deep snow restricting access to forage and heightened energy expenditures associated with locomotion in deep snow and thermoregulation in plummeting temperatures. Following the summer of 2017, we saw collared individuals entering the 2017/2018 winter in the best condition that we have observed in this population, with body fat levels close to two times the levels what we had seen in the autumn of 2016.

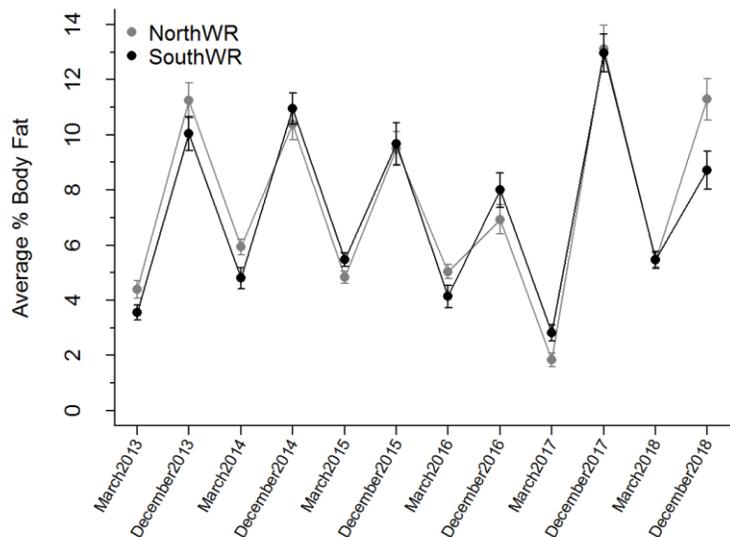
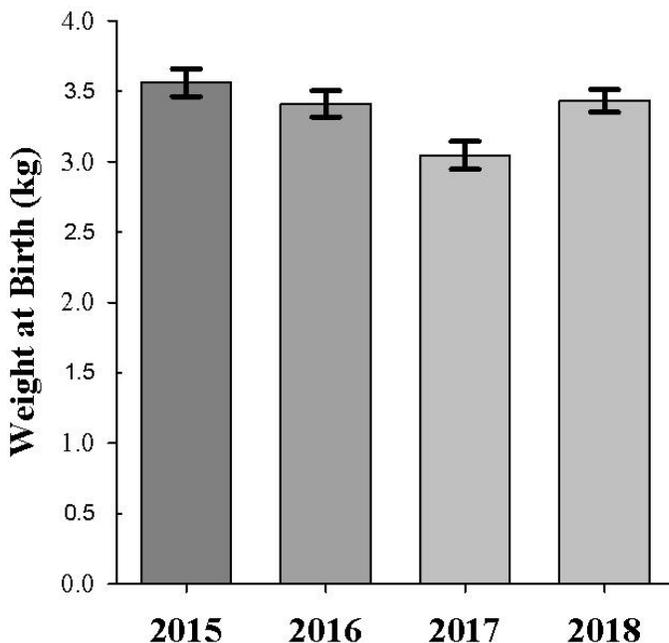


Figure 4. Average percent of ingesta-free body fat of adult, female mule deer in the Wyoming Range from March 2013 to December 2018.



We saw the effects of the harsh winter in 2016-17 in fawns born in the summer of 2017. Newborn fawns caught in 2017 were significantly lighter than newborn fawns caught in previous years, and over a quarter of the summer mortalities that year were from collared females giving birth to stillborns. In line with poor development of offspring at birth was the smallest eye diameter of fetuses measured in March 2017. In 2018, not only had eye diameter of developing fetuses climb to higher levels that we had seen previously, birth weights also increased back to levels that were comparable to what had been seen in the population before the summer of 2017. With this information, we are now in a position to better evaluate the influence of birth weight and maternal condition on summer survival of fawns.

Following the severe winter of 2016-17, the Wyoming Range mule deer population had found itself in an interesting place. The high adult mortality and depressed reproduction in the summer



following undoubtedly resulted in decreased abundance of deer in the Wyoming Range. The silver lining to the decrease in the population is that population growth is often higher when abundance is low.

As the density of deer decreases, the food available to each individual on a landscape increases. Consequently, populations at low abundance, relative to the capacity that their landscape can support, tend to be in overall better nutritional condition because each individual has access to more food. Conversely, deer populations that are at or exceeding the capacity a landscape can support tend to be in overall worse nutritional condition

because deer are competing with each other for food. Some of these trends are reflected in our longitudinal data of trends in fat dynamics since 2013. Deer were in the poorest nutritional condition we had observed in March 2017, and following the population crash and reduction of individuals on the landscape, we observed the best nutritional condition we've ever seen in this population in December of 2017.

The effects of the 2016-17 winter has been distressing, but we now are uniquely poised to document the long-term effects of severe winters and understand the factors that will influence population recovery from the devastating losses. We have been extremely fortunate to have been conducting research on this herd, not only through the course of this harsh winter, but for several years prior, which will yield the data to address questions associated with how severe winters may affect mule deer herds throughout the state. With dramatic reductions in density, forage resources available per individual should be bolstered and thus, nutritional condition, reproductive success, and survival may well all respond very favorably. Nevertheless, with lower deer density compared with recent decades, the role of predators in this population also may change in either positive or negative ways. The marked decline of the Wyoming Range deer population following the 1992-93 winter, and the near absence of any substantial recovery thereafter, also begs the question to what extent recovery will occur given historic patterns. Regardless, the overwhelming management desire is for recovery, and our aim is to document recovery and the mechanisms that underpin it



Understanding the Ecology of Male Mule Deer in the Wyoming Range

The Wyoming Range mule deer herd holds substantial cultural and economic importance, in part, because of the opportunities it provides for hunters from both Wyoming and throughout the West to harvest male deer, and for some, to harvest large males. Despite the importance of male mule deer in the Wyoming Range to both the public and economy, we still lack fundamental understandings of much of the ecology of males (i.e., migratory behaviors, vulnerability to harvest, dispersal from natal home ranges), and thus, many questions arise as to how season dates should be established, how male deer respond to harvest pressure, and whether males are being recruited into older age segments. Or for example, even more basic questions associated with how population processes are stocking high-elevation basins with male deer remains largely unknown.



Mark Gocke

Beginning in the autumn of 2018, we began to collar male mule deer as part of the Wyoming Range Mule Deer project, and hope to continue these efforts over the next three years. The Wyoming Range Mule Deer project has begun to disentangle many of the factors that may regulate mule deer herds in Wyoming, but there is still a critical gap in understanding the ecology of this herd. Despite the fact that males are often the segment of the population most valued by the public, there exists little information on how their ecology differs from females, and thus, how males may behave or respond differently from females to regulating or limiting factors. Indeed, harvest of females has been restricted almost completely in the Wyoming Range since 1993 and thus, almost all harvest-related opportunity in the population is provided by the male segment. The Wyoming Range herd is universally considered by many as one of the premier herds for hunting large mule



deer in North America. Accordingly, most conversations associated with management of the Wyoming Range herd, and many others for that matter, is focused around harvest of males. Outside of antler morphology characteristics and age specific data that is collected in the field by managers subsequent to harvest, little information is available that contributes to the management of the male cohort. In fact, other than posthunt male:female ratios, there are no other long-term, consistently obtained or reliable data sets that describe the annual population dynamic, or effects of management action on the 1+-year old cohort of males. Consequently, we generally lack empirical information to help inform discussions as to management of males. This discussion occurs at a time when segments of the hunting public are asking for a dichotomous, and inherently conflicting, set of management actions be implemented that dramatically restricts hunting of males, as well as providing increased opportunity to harvest trophy class males during the migratory period (i.e., longer hunting seasons) or when males arrive on winter ranges.

Existing evidence and theory indicates that male ungulates differ markedly in their behavior, nutritional dynamics, and growth, and as a consequence, can exhibit demographics divergent to that of females. It has been recommended that male ungulates be considered as essentially a different species compared with females, because of their striking differences in life history. Although they represent a flexible resource within populations because harvest of males plays little role in affecting population dynamics for polygynous ungulates, increasing interest in maintaining male:female ratios at specified levels and maintaining a specific age structure has become common criteria in management plans. Moreover, heightened discussions on harvest pressure and the topic of limited quota harvest regimes exemplify the need for additional insight into the ecology of male deer.





Future Directions

The overall goal of our continued work in the Wyoming Range will be to build on our understanding of nutritional and population ecology of this herd to answer a suite of questions that can only be addressed using long-term and continuous data. The mule deer of the Wyoming Range are one of the most cherished populations of wildlife in western North America, and we seek to gain a better understanding of how this population is responding to an increasingly changing environment, while simultaneously answering complex questions critical to advancing our understanding of this species that have long eluded ecologists. By following individuals from birth throughout their life, we can begin to better understand the behavioral and physiological adaptations these animals possess to persist in such a stochastic landscape, and identify what factors may play crucial roles on long-term population dynamics. Our work has begun to identify the effects of a severe winter on this population of mule deer, and we are now equipped to identify the severity and longevity of carryover effects on a population following an extreme winter. Further, we are beginning to understand how migratory patterns are passed from generation to generation, and will soon be able to assess how those patterns differ between males and females, and ultimately what dictates patterns of occupancy by deer across a diverse landscape. Our approach will allow us to continue to elucidate the relative roles of habitat, nutrition, predation, and disease on the regulation of deer in western Wyoming, and to begin to address questions that require long-term data but are crucial to the successful management of mule deer in Wyoming.

Partners

The Wyoming Range Deer Project is a collaborative partnership in inception, development, operations, and funding. Without all the active partners, this work would not be possible. Funds have been provided by the Wyoming Game and Fish Department, Wyoming Game and Fish Commission, Wyoming Wildlife and Natural Resource Trust, Muley Fanatic Foundation, Bureau of Land Management, Knobloch Family Foundation, U.S. Geological Survey, National Science Foundation, Wyoming Governor's Big Game License Coalition, Boone and Crockett Club, Animal Damage Management Board, Ridgeline Energy Atlantic Power, Bowhunters of Wyoming, and the Wyoming Outfitters and Guides Association. Special thanks to the Wyoming Game and Fish Department, Bureau of Land Management, and Wyoming State Veterinary Lab for assistance with logistics, lab analyses, and fieldwork. Also, thanks to the Cokeville Meadows National Wildlife Refuge and U.S. Forest Service for providing field housing.



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Kevin Monteith

Kevin Monteith is an Assistant Professor of the Haub School of Environment and Natural Resources and the Wyoming Cooperative Fish and Wildlife Research Unit, Department of Zoology and Physiology at the University of Wyoming. After receiving his BSc and MSc in Wildlife and Fisheries Sciences from South Dakota State University, he went on to obtain his PhD in Biology from Idaho State University in 2011. Kevin's research program is focused on integrating nutritional ecology with intensive field studies of large ungulates to elucidate the mechanisms that underpin behavior, growth, reproductive allocation, predator-prey dynamics, and ultimately, the factors affecting population growth. Kevin and his graduate students are currently conducting research on most of Wyoming's large ungulates; topics are centered on establishing a protocol for habitat-based, sustainable management of ungulate populations, while investigating the effects of predation, habitat alteration, climate change, migration tactics, and novel disturbance.



Ellen Aikens

Ellen is a PhD candidate in the Program in Ecology at the University of Wyoming. Ellen is fascinated by animal movement, especially migration. Ellen plans to pursue a career in research, with a focus on the interface between fundamental research and applied conservation and management. Before coming to Wyoming, Ellen worked at the Smithsonian Conservation Biology Institute's GIS lab, where she analyzed remote sensing and GPS telemetry data for conservation research projects across the globe. Ellen is a recipient of the National Science Foundation Graduate Research Fellowship and the Berry Fellowship. Ellen earned her bachelor's degree in Biology and Environmental Studies from Ursinus College.



Samantha Dwinnell

Samantha Dwinnell is a Research Scientist with the Haub School of Environment and Natural Resources. Samantha is the first student to miraculously graduate (May 2017) with a MSc from the Monteith Shop. Immediately following her defense that was made successful through bribery, she foolishly convinced Dr. Monteith to hire her as a Research Scientist to manage the Wyoming Range Mule Deer Project. Samantha's graduate research was focused on the nutritional relationships among mule deer behavior, forage, and human disturbance. Currently, her research is focused on disentangling the relative influence of various factors that affect fawn survival. Although Samantha is most interested in research aimed at informing management and conservation of wildlife, she also dedicates research efforts into finding ways to mountain bike and ski without her boss knowing.



Rhiannon Jakopak

Rhiannon is currently a master's student in the Cooperative Fish and Wildlife Research Unit at the University of Wyoming. She received dual bachelor's degrees in Wildlife and Fisheries Biology and Management and Religious Studies at the University of Wyoming in 2016. She is broadly interested in population ecology and mammalogy, and more specifically interested in the processes regulating the distribution of species. Her master's project seeks to identify the factors which influence the development of migration and the subsequent population consequences.



Taylor LaSharr

Taylor LaSharr is a PhD student in the Cooperative Fish and Wildlife Research Unit. Taylor is originally from Phoenix, AZ and attended the University of Arizona where she obtained a BSc in Natural Resources with an emphasis in Conservation Biology and a minor in Chemistry in May of 2015. During her time at the University of Arizona, she studied life history tradeoffs in Western and Mountain Bluebirds and the effects of aggression in closely related species on habitat and range dynamics. She completed her MSc in the Monteith shop in the spring of 2018 assessing the effects of harvest on horn size of mountain sheep. She now is working on a component of the Wyoming Range Mule Deer Project assessing population recovery following a severe winter for her PhD research.









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