# The Wyoming Mule Deer Initiative

**Prepared by the Mule Deer Working Group, Wyoming Game and Fish Department**

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# MULE DEER WORKING GROUP MEMBERS AND OTHER CONTRIBUTORS

**Mule Deer Working Group Members:**
Justin Binfet, Casper Wildlife Management Coordinator
Gary Fralick, South Jackson Wildlife Biologist
Scott Gamo, Habitat Protection Biologist
Adam Hymas, Big Piney Game Warden
Teal Joseph, West Rawlins Game Warden
Daryl Lutz, Lander Wildlife Management Coordinator and Chairman
Jill Randall, Pinedale Habitat Biologist
Will Schultz, Saratoga Wildlife Biologist
Jeff Short, Mountain View Wildlife Biologist
Ian Tator, Habitat Program Manager and Co-chairman
Steve Tessmann, Staff Biologist
Dan Thiele, Buffalo Wildlife Biologist
Tim Woolley, Cody Wildlife Management Coordinator

**Past Contributing Members:**
Bill Brinegar, South Laramie Game Warden
Bill Robertson, Greybull Game Warden

**Other Contributors:**
Justin Clapp, Large Carnivore Biologist
Dan Bjornlie, Large Carnivore Biologist
Dan Thompson, Large Carnivore Section Supervisor

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# EXECUTIVE SUMMARY

The Wyoming Mule Deer Initiative (WMDI) was formally adopted by the Wyoming Game and Fish Commission (Commission) in July, 2007. Both the 2007 version and this update were products of a collaborative effort by the Wyoming Game and Fish Department's (WGFD) Mule Deer Working Group (MDWG). The MDWG was established in Spring, 1998 to explore solutions to the many formidable challenges impacting health and viability of our mule deer herds. The current revision is a natural progression toward improving management and focusing resources on this species. Since 2007, the Mule Deer Initiative has gained traction throughout the state and demonstrated considerable success engaging the public. Our collaborative efforts have improved management decisions through more effective public involvement and interaction.

The revised WMDI is tiered from the Western Association Fish and Wildlife Agency's (WAFWA's) North American Mule Deer Conservation Plan (Mule Deer Working Group, 2004). Many of the management challenges we face in Wyoming also impact mule deer throughout their range in the United States, Canada, and Mexico. For that reason, similar initiatives or management plans have been, or are being developed in other States and Provinces.

From the perspective of many stakeholders, managing mule deer would seem a relatively basic and straightforward endeavor. In reality a myriad of complex factors are affecting mule deer populations throughout their range. This Initiative will lay the groundwork for future conservation and management of mule deer in Wyoming. Many of the objectives and strategies we advocate are currently being implemented within WGFD's existing management programs. Others will provide an essential pathway for adapting to the changing environmental and social pressures affecting mule deer and their management in Wyoming.

It is important to recognize our understanding of mule deer ecology and management is incomplete. As the knowledge base continues to grow, the WMDI and WGFD's mule deer management program will be appropriately adjusted and adapted to apply new, more effective techniques and strategies that enable us to improve the management of this valuable resource.

Employing the best available science and effectively involving the public in decision-making processes will best position WGFD to address mule deer management challenges in the 21$^{st}$ century. The overarching goals and objectives outlined in this initiative will provide guidance for developing individual herd unit management plans and strategies. Successful implementation will depend on our ability to identify and manage the factors that limit mule deer populations, primarily related to habitat conditions. This in turn will depend on our ability to secure funding and public support. Forging cooperative relationships with private landowners will also be crucial as will the need to work closely with federal land managers.

# MULE DEER IN WYOMING

Wyoming's mule deer are valued for the important aesthetic, cultural, economic, and ecological roles they fulfill. The species thrives in habitats ranging from salt desert shrublands to alpine tundra. By most historical accounts, mule deer were uncommon in the 19th and early 20th centuries, then reached their maximum abundance during the 1950's and 60's. Today, most wildlife managers acknowledge the high mule deer densities of the 1950's and 60's were unsustainable, and likely exceeded the long-term carrying capacity of the landscape resulting in widespread over-use and degradation of key habitats. Mule deer throughout the West declined markedly in the last decade of the 20th century and first decade of the 21st century. In Wyoming, the most recent population peak occurred in 1991, when about 578,000 mule deer inhabited the state. By 2013, mule deer had declined 39% to an estimated 353,000 animals.

Densities of mule deer vary greatly across the species' range. Some productive habitats support comparatively dense mule deer populations, whereas others sustain sparser numbers. Many formerly productive habitats have been depleted by historically overabundant mule deer herds and/or have been degraded and fragmented by development and land uses. In the absence of controlled harvest, mule deer typically increase until they overuse the available forage, leading to a higher likelihood of disease and weather-related mortality. Under such conditions, mule deer are prone to "boom and bust" cycles, increasing to unhealthy levels and then declining abruptly to extremely low densities. Recovery of habitat conditions following boom cycles can be very protracted. In light of current habitat conditions and public expectations, allowing extreme boom and bust cycles is not acceptable mule deer management. The Wyoming Game and Fish Commission establish harvest quotas and season frameworks to maintain sustainable mule deer populations commensurate with the availability and condition of key habitats, and to manage numbers and distribution of hunters.

Mule deer and other big game in Wyoming are managed based on a "herd unit" (or delineated population) concept. There are 37 recognized mule deer herds in the state (Fig. 1). A herd is a distinct population of mule deer having very little interchange with other herds. The mule deer that comprise each herd tend to remain in certain geographic regions (although the regions can be quite large), and use traditional birthing areas, summer habitats, migration corridors and winter ranges from year to year. Herd sizes vary from a few hundred in the smallest herds, to tens of thousands in the largest. WGFD has further divided each herd into one or more hunt areas in which specific harvest regulations are prescribed.

All mule deer in Wyoming are "free-ranging" and depend predominantly on natural habitats. The most productive segments of mule deer herds evolved to migrate between seasonal habitats located within distinct segments of the landscape. Consequently, activities disturbing even a small portion of a herd's seasonal ranges can have major population-level consequences. For example, many mule deer herds migrate to traditional winter ranges where they can move about more freely to find food and cover when deep snow accumulates on summer ranges. Winter ranges tend to be much more limited in area, forcing mule deer to

congregate at much higher densities. Thus, a comparatively small loss of winter range can be as destructive as a much larger impact on summer range. Similarly, developments that disrupt a traditional migration route can also jeopardize a large segment of the herd.

Over thousands of years, mule deer have evolved physical adaptations to Wyoming's harsh and variable climate. However, weather patterns can become severe enough at times to significantly increase overwinter mortality. The most extreme impacts happen when two or more stressful climatic events coincide, for example summer drought followed by a cold winter with prolonged, deep snow. Drought cycles reduce the amount and quality of forage and the availability of water sources. During these harsh conditions, mule deer are unable to accumulate sufficient fat reserves and thus enter the winter in poor condition. Inevitably, weakened mule deer succumb to higher mortality rates, especially under normal to severe winter conditions. In addition, recent research has established that birth rates and fawn survival are significantly correlated with the health of adult females entering the previous winter. When female mule deer enter winter in poor body condition, they are less likely to produce offspring that will survive to adulthood.

Populations of mule deer have always fluctuated naturally in response to climate and other environmental variables. Historically, mule deer habitat was in much better condition and populations rebounded quickly after comparatively short-term declines. However, in recent years Wyoming's landscape has changed dramatically with many habitats altered in ways that are relatively permanent. New and upgraded highways, housing developments, ranchettes, oil/gas fields, reservoirs, and other large-scale developments are fragmenting mule deer ranges and diminishing habitat suitability over large areas. Invasive and noxious weeds such as cheatgrass have also compromised the integrity of many mule deer ranges throughout the West and in Wyoming. The Nation's increasing demand for domestically-produced energy has given rise to unprecedented resource development throughout Wyoming, and is altering habitat at a much greater rate than can be restored by reclamation. This impact is exacerbated by other long-term pressures on the land, including drought and heavy utilization by ungulates (both wild and domestic), causing a general decline in the condition and quality of the remaining habitats.

Mule deer are predominantly browsers that rely on shrub communities to supply most of their food and cover. Unfortunately, the majority of shrub communities are in late seral stages (over mature) throughout Wyoming and the Intermountain West. For shrub communities to remain productive succession must be periodically set back by natural disturbance events or managed treatments (e.g. fire). Key objectives of the WMDI are to increase the public's awareness of and involvement with the issues affecting mule deer and to promote conservation of the species and its habitat into the future.

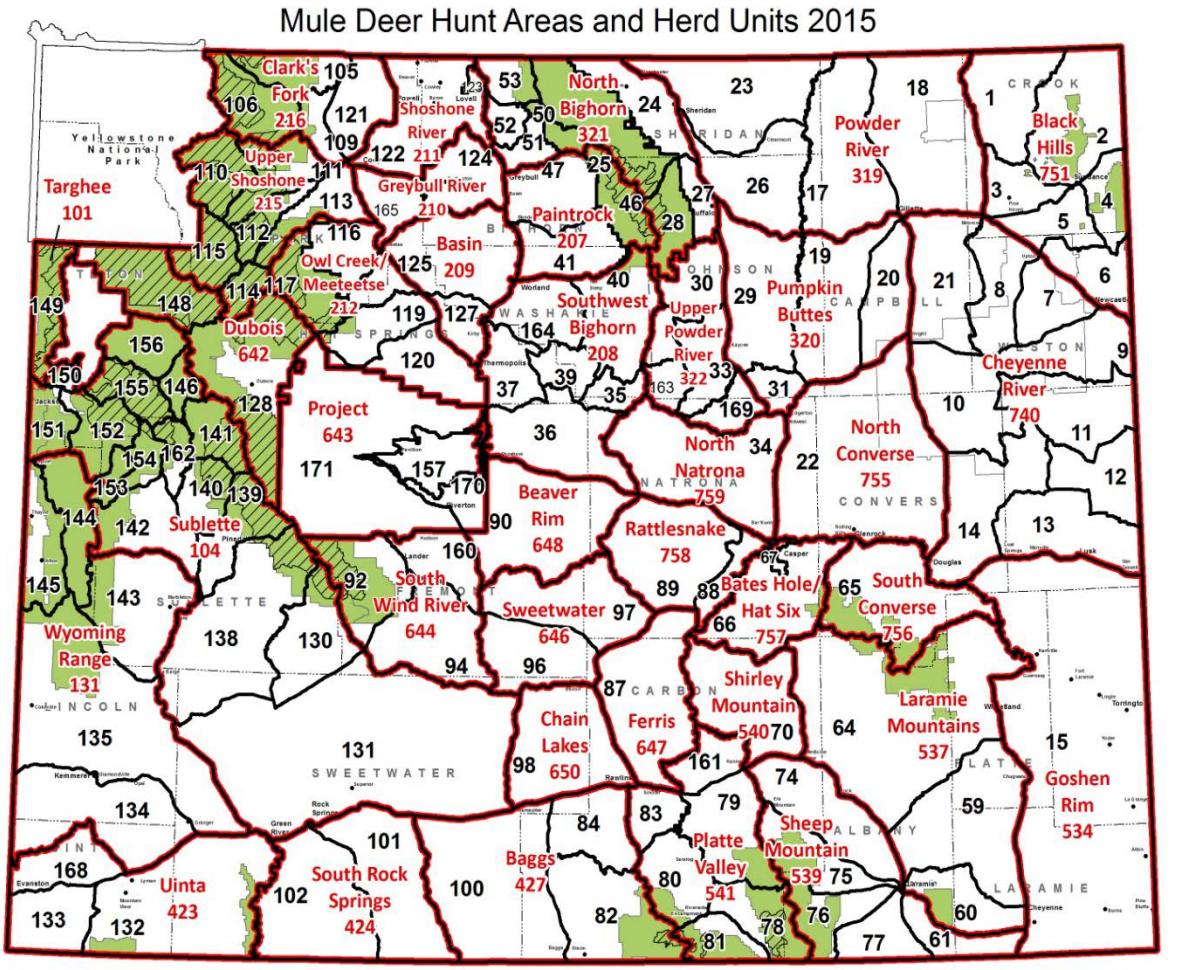


*Fig. 1. Mule deer herd units and hunt areas, 2015.*

# THE MULE DEER INITIATIVE

The Wyoming Mule Deer Initiative (WMDI) identifies the most pressing issues affecting mule deer, establishes goals and objectives for management, and recommends implementation strategies. The strategies include a broad range of program-level actions. While much is yet to be done, we provide examples of management actions being implemented to address many of the issues. These examples are not all inclusive. The intent ultimately is to continue improving the effectiveness of our mule deer management program and to better engage and involve the public in developing management recommendations. The overarching goals and objectives set forth in this initiative are intended to provide guidance for developing individual herd unit management plans and strategies. These herd unit plans will identify specific issues, opportunities, and management actions on a local and regional scale.

The WMDI is intended to focus efforts and available resources by emphasizing the following goals:

1. Conserve, enhance and restore mule deer habitat essential for population maintenance, reproduction and survival;
2. Through hunting frameworks, manage mule deer populations at sustainable levels that will maintain productive habitat conditions and provide recreation opportunity;
3. Apply the best available science, within budgetary constraints, to monitor mule deer populations and habitat condition;
4. Develop cooperative working relationships with universities and other institutions to conduct applied research needed to improve mule deer management;
5. Increase stakeholder awareness of and involvement with the issues affecting conservation of mule deer, as well as opportunities to address those issues;
6. Enhance funding and public support for mule deer management; and
7. Collaborate with federal and state land management agencies to develop land use policies that will conserve and improve mule deer habitats.

Factors that impact or limit mule deer populations are described below:

1. Altered fire intervals, invasive plants, and historically heavy use by ungulates (both wild and domestic) are causing long-term declines in productivity of many mule deer ranges.
2. Habitats are being converted and fragmented by expanding human populations, urbanization, increased recreational activity, mineral and energy development, and other intensive uses of the land.
3. Climatic extremes such as drought and severe winters impact quality and quantity of habitat, and lower recruitment of mule deer fawns to breeding age. Biologists and researchers are considering long-term implications of global climate change.

4. Competition with elk, white-tailed deer, feral horses, and domestic livestock can negatively affect mule deer. The impact of competition increases when condition and availability of habitats decline or where important habitats are limited.
5. Predation is a natural ecological process that acts in concert with habitat conditions and availability of alternate prey. In many ecosystems, mule deer coevolved with, and are preyed upon by multiple predator species such as mountain lions, coyotes, black bears, grizzly bears, and wolves. However, quantity and quality of habitat ultimately determine the number of mule deer that can be supported. Although predator control may be beneficial on a local scale, it can actually result in overuse of habitat by enabling mule deer to increase above the numbers the habitat can support at any given time. Conversely, when mule deer populations are depressed below carrying capacity, predator control can be beneficial and allow the mule deer population to recover more quickly.
6. Hunting frameworks can alter the size of a mule deer population and its age and sex structure. License allocation systems (e.g., general vs. limited quota) and season structures also affect hunting quality, hunting opportunity, and our ability to manage mule deer populations.
7. At times, diseases such as epizootic hemorrhagic disease (EHD) and chronic wasting disease (CWD) cause significant mule deer mortality. However, the impacts of such events are not fully understood. By monitoring disease outbreaks and prevalence, managers will improve their capability to predict changes in mule deer abundance and forewarn hunters and others about the prevalence of disease.
8. Off highway vehicle access, all terrain vehicles (ATVs), and snowmobile use have increased markedly. This activity can displace mule deer from preferred habitats, increase stress, and cause mule deer to expend additional energy. In addition, ATV use detracts from the quality of hunting for some and reduces hunter success, thereby impacting management goals.
9. Access to private lands and landlocked public lands has become increasingly restricted in some portions of the state. This has reduced hunting opportunity and the ability to achieve harvest objectives. Hunter crowding is also increased on accessible public lands.

Wildlife managers obviously cannot control weather or climate change. Our basic role is to prescribe hunting frameworks needed to manage mule deer populations within the existing capability of the habitat, in order to protect the habitat base, lessen the effects of weather, disease or other factors, and provide a range of recreation opportunities. In a majority of areas, we set season frameworks that emphasize opportunity. In others, we emphasize higher success rates and harvest of mature bucks. We also collaborate with land management agencies and private landowners by promoting programs that will protect and improve existing habitats and avoid, minimize, or mitigate adverse impacts from mineral and energy production and other intensive land uses. Where predation and competition with other wildlife are demonstrated to have an additive impact on mule deer survival, we will also consider cost-effective means to reduce those impacts.

This initiative strives to accomplish WMDI goals by addressing the following 10 major issues impacting mule deer:

1. Habitat Management;
2. Population Management (includes harvest and hunter management);
3. Predator Management;
4. Diseases;
5. Law Enforcement;
6. Weather;
7. Elk and Deer Interactions;
8. Public Outreach and Collaboration;
9. Research; and
10. Funding and Support.

WGFD is committed to reevaluate and improve its mule deer management program on a continuing basis. Given sufficient resources, we will strive to enhance our management capabilities, ensure the long-term sustainability of mule deer populations, and provide quality hunting opportunities for present and future generations.

# Habitat Management

In his book, Mule and Black-tailed Deer in North America, Wallmo (1981), stated:

> *"In my view, the only generalization needed to account for the mule deer decline throughout the West is that practically every identified trend in land use and plant succession on the deer ranges is detrimental to deer. Hunting pressure and predators might be controlled, and favorable weather conditions could permit temporary recovery, but deer numbers ultimately are limited by habitat quality and quantity."*

The Mule Deer Working Group of the Western Association of Fish and Wildlife Agencies (WAFWA) defines habitat as those resources and conditions present in an area that allow an animal or population to live, survive and successfully reproduce (deVos et al. 2003). Stakeholders often have an expectation that wildlife populations should be perpetually managed at maximum levels for aesthetic, recreation, and other interests. Habitat managers often find it difficult to convince wildlife enthusiasts that this is generally unsustainable. Unrealistic expectations commonly derive from what people recall historically based on high points during cyclical irruptive phases in the population. It can be difficult to recognize how the landscape has changed over time intervals spanning decades, or how those changes have negatively altered mule deer habitats.

Mule deer in Wyoming occupy diverse habitats that include riparian corridors, juniper/ponderosa pine breaks and ridges, sagebrush steppe, brushy foothills, high elevation timber and parks, agricultural lands, and at times, alpine tundra and talus slopes above timberline. The basic components of habitat include food, water, cover, and open space juxtaposed within the animal's mobility range. The maximum number of mule deer an area can support and sustain over time is commonly called "carrying capacity." Carrying capacity is determined by the amounts of food, cover, and water available in an area to support a given number of mule deer, and can vary with time. When a mule deer population outstrips the available food, the herd has exceeded the habitat's carrying capacity. Under these circumstances, mule deer body condition and productivity typically decline. Chronic overuse further diminishes the ability of the habitat to support mule deer and may alter the composition and productivity of vegetation for many years.

The nutritional condition of doe mule deer entering the winter determines their reproductive success and survival (Tollefson et al. 2010, 2011; Monteith et a. 2013). While WGFD continues to place a high priority on improving and maintaining winter ranges, we are focusing increased management emphasis on summer and transitional ranges. The 2014 Strategic Habitat Plan and recently produced "Recommendations for Managing Mule Deer Habitat in Wyoming" prioritize these areas for habitat enhancement work (WGFD *in review* 2015).

Food is a key factor influencing how mule deer use their habitat. The characteristics that most influence the kinds of plants mule deer select seasonally are palatability, availability, and succulence. Mule deer forage mainly on shrub leaves, buds, and stem tips in the fall and winter. In spring and summer, they rely more on forbs (broad leafy plants) and grasses, which are green, succulent, and high in protein.

Although mule deer require a certain quantity of forage to survive, low quality forage, even when available in large quantities, may be inadequate to support the herd. Mule deer must derive sufficient energy, protein, and nutrients from the plants they eat in order to maintain body condition and reproduce successfully. Nutrition influences overall body condition, ovulation, conception, gestation, lactation, survival, and home range size on a seasonal and annual basis. Nutrition also affects winter survival, size at birth, timing of birth, survival of fawns, and even sex composition of fawns. For example, does in good condition bear healthier fawns and more twins. The female fawns they bear have relatively higher survival rates compared to fawns of nutritionally-stressed does. Low birth weight often predisposes fawns to higher mortality later in the season. Nutritional status also affects vulnerability to predation, as well as the ability to compete for food and survive when severe weather persists for extended periods. Finally, mule deer have a relatively small rumen and digestive tract, and cannot adapt to rapid changes in diet composition. Consequently, supplemental feeding is an inefficient and ineffective means of increasing mule deer survival during severe winters. The primary cause of winter starvation is almost always poor habitat conditions throughout seasonal ranges and sometimes too many mule deer. History has demonstrated some winters are so severe significant mortality will happen regardless of habitat quality or availability. WGFD has developed criteria to evaluate whether or not to implement a feeding program (Appendix 1).

Water is a critical element of mule deer habitat throughout Wyoming and is especially important in arid climates. Water intake varies depending on temperature, humidity, moisture content of forage, rate of forage consumption, and other factors. Mule deer generally obtain much of the water they need from succulent forage, however, availability of freestanding water is important when mule deer consume large amounts of cured vegetation and also when does are lactating. In winter, mule deer normally obtain sufficient water by eating snow.

Cover is the other major physical component of mule deer habitat. Types of cover include thermal cover used to minimize exposure and energy loss, and security or escape cover used to avoid detection, to evade predators, and even to avoid harvest by hunters. Mule deer are adept at using trees and shrubs as security cover. Topographic features such as canyons, rocks and river breaks also provide cover. Cryptic coloration greatly enhances the ability of mule deer to hide, making them difficult to detect even when they are standing in the open. Most features that will hide a mule deer also afford thermal protection from wind and cold weather.

Numerous factors have contributed to loss and fragmentation of mule deer habitats in Wyoming. Some of the more important include: energy and mineral exploration and extraction; urban growth and rural subdivision development; degradation of native rangelands due to invasive plants including cheatgrass; natural events such as precipitation, drought, and severe winters; construction of highways, railroads, fences, large reservoirs and other impediments to migration. In addition, motorized recreation activities such as snowmobiling and off-highway vehicle use can also create additional stress and potentially displace mule deer from important habitats. Global climate change may also exacerbate several of these effects (deVos and McKinney 2007). These types of disturbance impact the ability of mule deer to effectively use seasonally important habitats, leading to increased mortality, reduced reproductive success, and displacement of mule deer into less suitable areas.

Mule deer habitats are also altered by many land management practices including historic fire suppression, improper livestock grazing practices, shrub eradication projects, and activities that increase spread of cheatgrass and other invasive plants. Ungulate browsing pressure (both by wild and domestic animals) and loss of natural fire cycles have led to a decline in the quantity and condition of important habitats, particularly aspen and mixed-mountain shrub communities. These communities evolved with varying intervals of wildfire, and depend on fire as an occasional disturbance to rejuvenate plant productivity and nutritional content. Shrub eradication projects designed primarily to increase grass production have reduced availability of shrubs that provide essential food and cover, especially on mule deer winter ranges. Invasive plants such as cheatgrass, knapweed, thistle, and others are increasingly out-competing native shrubs, forbs and grasses on important mule deer ranges. Some of these weeds, such as cheatgrass, are highly flammable and increase the frequency and intensity of damaging wildfires beyond natural fire regimes, which can ultimately eliminate native shrubs and other plants. Juniper and conifer stands can provide important mule deer cover, but also reduce sunlight and moisture reaching under-story vegetation. When these species expand into important shrub-dominated habitats and aspen communities they often out-compete and eliminate important native forage plants. Juniper and conifer invasion throughout the west is a direct consequence of long-term fire suppression. Depending upon the frequency and intensity of fire, along with a variety of other factors, fire can be either beneficial or detrimental to mule deer habitat. When fires occur too frequently due to invasive weed establishment, important shrub communities generally won't reestablish. However, when fires are suppressed for too long, as has been the case throughout much of Wyoming over the last century, many shrub communities become decadent, meaning they are less productive and far less nutritious.

Recurring and intensifying drought cycles have reduced the amount and quality of forage produced on many mule deer ranges, resulting in greater competition for the remaining food supply. Extended dry conditions also increase the frequency and intensity of wildfires to the point they become detrimental to some important plant communities. Most importantly, growth of herbaceous vegetation is greatly diminished and plants cure out more quickly

during drought regimes. This can result in a lack of adequate nutrition for doe mule deer to build adequate fat reserves entering the winter.

Vegetation manipulations, including mechanical and chemical treatments, prescribed fire, and re-seeding can be designed to improve and rehabilitate mule deer habitats. Some agricultural and livestock management practices can also be designed to benefit mule deer by increasing shrub productivity and vigor and by enhancing the herbaceous (forb and grass) component in the understory. When planning treatments or agricultural practices to modify vegetation conditions, refer to the "Recommendations for Managing Mule Deer Habitat in Wyoming," (WGFD's Mule Deer Working Group *in review* 2015).

Monitoring is essential to detect ecological trends and effectively protect and manage mule deer habitats at risk from ongoing and escalating impacts. It is also important to monitor effectiveness of habitat treatments and make adjustments where needed. Monitoring can be very costly and labor intensive to implement at a meaningful scale. However, evaluating habitat conditions and maintaining adequate amounts of high quality habitat are vital to sustain healthy mule deer herds. Managers continue to explore and refine cost-effective techniques to assess habitat condition in relation to mule deer densities.

The following management objectives and strategies are recommended to restore and sustain a quality habitat base for mule deer.

**Objective: Integrate habitat needs of mule deer and other species when planning and implementing habitat management projects.**

> ***Strategy: When treatments intended primarily to benefit other species are planned in mule deer habitats such as shrub-dominated winter and transitional ranges and aspen communities, proponents should evaluate the anticipated short and long-term effects on mule deer before treatments are implemented.***
>
> ***Strategy: Where other herbivores contribute to excessive browse utilization, advocate appropriate management actions to ensure utilization levels are sustainable.***
>
> ***Strategy: Habitat management plans designed primarily to benefit mule deer should include a detailed analysis of the effects treatments may have on other species such as sage-grouse, lynx, pronghorn, and neo-tropical migratory birds. To the extent possible and permissible, habitat treatments should be beneficial or at least neutral in their effect on other species. Short-term, adverse effects may be permissible if they are of limited scope and will be reversed through vegetation response and succession.***
>
> <u>*What's been done:*</u>
> ✓ *To be consistent with the Sage-grouse Core Area Protection policy as delineated*

*in the Wyoming Executive Order 2011-5, WGFD developed the "Wyoming Game and Fish Department Protocols for Treating Sagebrush" in 2011. This document is posted on WGFD's website.*

- ✓ *The Sage-Grouse Habitat Assessment Framework was produced by the BLM in 2010 and provides guidance on habitat suitability criteria for the different seasonal ranges used by sage-grouse. This document is also posted on WGFD's website.*
- ✓ *The Western Association of Fish and Wildlife Agencies published the draft Greater Sage-grouse Comprehensive Conservation Strategy in December, 2006.*
- ✓ *The State Wildlife Action Plan (SWAP) was approved by the Wyoming Game and Fish Commission in 2009 and is posted on WGFD's website. The Strategy lists species of greatest conservation need throughout Wyoming, including species inhabiting sagebrush and grassland ecosystems, and recommends conservation actions.*
- ✓ *Where excessive browse utilization levels have been documented, changes to hunting season structure have been implemented to bring wild ungulate populations in line with available resources.*

**Objective: Implement vegetation management practices and treatments to enhance and or protect mule deer habitat on a landscape scale, while considering both ecological and economic impacts.**

***Strategy: Conduct research and monitoring needed to better understand shrub ecology, the role of fire, and how vegetation responds to treatments intended to enhance wildlife habitat, mitigate impacts, or restore degraded communities. Focus research in sagebrush steppe, mountain shrub, aspen, conifer and riparian habitats. Continue to review current literature on these topics.***

***Strategy: Apply appropriate treatments to maintain health and productivity of mule deer seasonal ranges.***

***Strategy: Work cooperatively with land management agencies to implement monitoring programs that will detect and document potential decline or conversion of important habitats, especially on winter, summer and transitional ranges, and take appropriate action to avoid, minimize, or mitigate the impact.***

***Strategy: Ensure security cover requirements of mule deer are considered in all vegetation management plans.***

***Strategy: Provide for long-term protection of important mule deer habitats through land acquisitions, conservation easements, cooperative agreements and land-use management plans. Work with funding partners to implement habitat protection strategies.***

***Strategy: Work cooperatively with land management agencies to develop fire management plans and policies that, under appropriate conditions, allow natural ignition fires to burn when and where they will benefit mule deer.***

***Strategy: Encourage timber management activities designed to maintain and improve mule deer habitat, specifically including clear-cuts, stand thinning, and aspen and cottonwood enhancement.***

***Strategy: Work cooperatively with private landowners (ranchers/farmers) to obtain technical and financial assistance for enhancing mule deer habitat and to support agricultural practices that are beneficial to mule deer. Remain informed of Farm Bill programs that present opportunities to fund projects and coordinate with Natural Resource Conservation Service (NRCS) staff.***

***Strategy: Coordinate with wildlife agencies in neighboring states to cooperatively manage important habitats and share habitat management techniques and strategies.***

*What's been done:*

- ✓ *Recent habitat improvement projects that have been implemented include:*
  - *WGFD initiated the Wyoming Range Mule Deer Habitat Plan which proposes to treat over 30,000 acres on BLM, State and private land near Big Piney and LaBarge from 2014-2021.*
  - *WGFD has initiated the Platte Valley Habitat Partnership (PHVP) and set aside $500,000 of seed money toward implementation of habitat treatments and other actions to benefit mule deer in the Platte Valley. The PVHP's Mule Deer Habitat Plan has identified a suite of silvicultural practices including clear-cuts to improve mule deer habitat. To date, the PVHP has funded projects resulting in the treatment of ~7,400 acres in the Platte Valley.*
  - *As a result of the success in the Wyoming Range and Platte Valley WGFD initiated a statewide Mule Deer Initiative in 2014, which will focus on actions to improve mule deer populations statewide. Key herds have been selected for this initiative in each WGFD region.*
  - *WGFD routinely engages state and federal land management agencies to promote and implement habitat improvement projects designed to benefit mule deer.*
  - *WGFD developed mule deer winter habitat change thresholds to trigger an adaptive management response to mitigate oil and gas development impacts on Atlantic Rim.*
  - *WGFD participates in all federal land use management plans and several Coordinated Resource Management planning and allotment management planning efforts.*

**Objective: Identify areas at risk, where the cumulative effects of natural events and human activities have diminished, or threaten to diminish quantity and quality of mule deer habitats.**

***Strategy: Utilize and support the WISDOM (Wyoming Interagency Spatial Database and Online Management) Geographic Information System (GIS) to evaluate historic, ongoing, and future disturbances within important mule deer habitats to provide a basis for assessing cumulative impacts of proposed actions and to assist with planning mitigation and conservation.***

***Strategy: Develop GIS layers for mapping and updating quantity and condition of habitats within mule deer seasonal ranges, to serve as a basis for proposing management actions and habitat treatments designed to maintain mule deer populations.***

*What's been done:*

- ✓ *WGFD has participated in developing several GIS systems including:*
  - *WISDOM to improve Wildlife Environmental Review (WER) analysis and comment preparation;*
  - *Remote sensing to delineate land cover types;*
  - *Sagebrush treatment database [in coordination with the Wyoming Geograpnic Information Science Center (WyGISC)] to aid in development of treatments in sage-grouse occupied habitat; and*
  - *Wildlife and Habitat Biologists continually evaluate and update seasonal range mapping and WGFD's Strategic Habitat Plan crucial and enhancement area polygons.*

**Objective: Avoid or minimize impacts to mule deer migration routes.**

***Strategy: Work closely with the Wyoming Department of Transportation (WYDOT), irrigation districts, railroads, energy companies, and other entities to design projects that minimize barriers to migrating mule deer and to incorporate features (e.g., over- and underpasses, right-of-way (ROW) fences, project layout, etc.) that restore or improve migration over/through existing roads, highways, ditches, and other projects.***

***Strategy: Encourage WYDOT and county road departments to seed less palatable vegetation in highway rights-of-way to reduce vehicle/mule deer collisions.***

***Strategy: Recommend mule deer-compatible fence designs that minimize barriers and entanglements.***

***Strategy: Develop technical definitions for "ungulate migration corridor" and associated features.***

***Strategy: Continue to identify and map migration corridors throughout the state, assess risks to these migration routes, and develop solutions to potential conflicts.***

*What's been done:*

- ✓ The Trappers Point project was implemented near Pinedale by WYDOT and includes two overpasses, six underpasses and thirteen miles of fence to funnel wildlife;
- ✓ The Nugget Canyon project was implemented in cooperation with WYDOT and includes seven underpasses to funnel mule deer.
- ✓ Ongoing mule deer research with the University of Wyoming Cooperative Fish and Wildlife Research Unit (Coop Unit) and Western Ecosystems Technology Inc. (WEST) has identified stopover areas along identified migration routes;
- ✓ The Wyoming Migration Initiative is a cooperative project with many partners including Coop Unit and WGFD with objectives of advancing the understanding, appreciation, and conservation of Wyoming's migratory ungulates by conducting innovative research and sharing scientific information through public outreach;
- ✓ WGFD, in cooperation with the WYDOT, has developed a statewide mule deer/vehicle collision database;
- ✓ Research on fence specifications, highway warning signs and detection systems, and under-passes has resulted in modifications to improve animal movement and reduce collisions;
- ✓ WGFD has developed wildlife-friendly fence specifications in cooperation with the BLM and WYDOT;
- ✓ WGFD has worked with various cooperators including land management agencies, private landowners and non-governmental organizations to identify and protect important migration corridors such as Trappers' Point, routes across Anadarko Corporation's properties, and those circumnavigating Fremont Lake; and
- ✓ WGFD has convened a committee to develop technical definitions for "ungulate migration corridor" and associated features. Migration corridors are being delineated using GPS technology on big game seasonal range maps.

**Objective: Maintain and improve programs and techniques to monitor the condition of mule deer habitats and mule deer response to vegetation treatments.**

***Strategy: Continue monitoring vegetation conditions in key mule deer habitats.***

***Strategy: Establish new vegetation transects in all seasonal ranges to monitor important habitats in select herd units in each region. At a minimum, data should include forage utilization measured in spring and productivity measured in fall.***

***Strategy: Inform federal agencies when data indicate habitats are in poor condition. Encourage changes in land/habitat management to restore habitats that***

***are in poor condition.***

***Strategy: Evaluate herd management objectives (i.e., population-based objectives). As appropriate, adjust objectives to maintain herds in balance with habitat condition and availability.***

***Strategy: Continue to evaluate all seasonal range delineations. As appropriate, adjust them to reflect changes in mule deer distribution and habitat use or based on improved data.***

***Strategy: Work with land management agencies and private landowners to incorporate mule deer habitat monitoring in their programs.***

*What's been done:*

- ✓ *Cutting edge research in the Wyoming Range and Little Mountain areas, led by Coop Unit and WGFD is investigating relationships between habitat quality and nutritional condition of mule deer.*
- ✓ *WGFD updated the Strategic Habitat Plan in 2014. Following the plan's guidance, WGFD has identified priority mule deer transitional habitats statewide.*
- ✓ *Methodologies have been standardized statewide for monitoring winter range vegetation. Methodologies are also being standardized for monitoring vegetation in summer and transitional habitats.*
- ✓ *The Wyoming Range and Platte Valley Habitat Assessments were conducted in 2008-2010 to evaluate current habitat conditions and direct future management actions to improve habitat.*
- ✓ *WGFD personnel meet annually with BLM, USFS, NRCS, and other land management agencies to discuss habitat conditions, vegetation treatment projects, and recommend future management actions.*

**Objective: Mitigate impacts of large-scale natural resource developments. Project development and operations plans should include avoidance as well as both onsite and offsite mitigation, as appropriate, to offset unavoidable habitat losses and maintain mule deer populations.**

***Strategy: Apply the Wyoming Game and Fish Commission's Mitigation Policy and WGFD's "Recommendations for Development of Oil and Gas Resources within Crucial and Important Habitats" (WGFD 2010a) to develop mitigation plans for every oil/gas field impacting crucial mule deer habitats.***

***Strategy: Engage individual energy companies and appropriate state and federal agencies to develop and implement effective reclamation and mitigation strategies.***

***Strategy: Advocate for continued improvements in technological capabilities to reduce and mitigate energy development impacts.***

***Strategy: As stipulated in WGFD's wind energy recommendations, insist that federal land management agencies, permitting agencies, and wind energy companies fund and conduct adequate research evaluating the extent to which commercial-scale wind farms impact mule deer and other wildlife (WGFD 2010b:49). This research needs to be completed before significant additional wind energy development takes place in Wyoming. Based on research findings, develop appropriate siting, design, and mitigation considerations to avoid and minimize impacts. Until the research is completed, wind farms should not be located in important mule deer habitats or migration corridors. Unpublished research in Oregon has documented elk mule deer displacement from wind facilities (ODFW 2010).***

***Strategy: Become involved at the earliest possible stage in federal planning processes that relate to exploration and development of mineral and energy resources. Put together alternatives, including operational practices that least impact mule deer and their habitat (e.g., "Best Management Practices") and develop mitigation plans to offset habitat losses and other impacts.***

***Strategy: Encourage the BLM to withdraw important mule deer habitats from consideration for oil/gas leasing and other industrial developments.***

***Strategy: In cases where important mule deer habitats have already been leased, work with the BLM and leaseholder to minimize the footprint of disturbance through directional drilling and other Best Management Practices which promote conservation of wildlife resources.***

***Strategy: Defer mineral leasing and development until appropriate technological capabilities have been developed to effectively avoid, minimize, and mitigate adverse impacts.***

*What's been done:*

- ✓ *WGFD is actively working with industry, BLM, the Governor's Planning Office, and several interest groups to develop effective means of addressing energy impacts, including impacts that have affected mule deer herds.*
- ✓ *The Jonah, Pinedale Anticline and Atlantic Rim mitigation teams work to develop projects to enhance mule deer habitat to offset impacts on the populations resulting from energy development.*
- ✓ *Seeding trials have been conducted in partnership with energy companies, NRCS and BLM to improve seed mixes and reclamation techniques in low precipitation vegetation types.*
- ✓ *WGFD coordinates closely with the BLM and USFS during the development and review of Resource Management Plans and Forest Management Plans, respectively.*

- ✓ *WGFD is actively exploring ways to resolve conflicts between wildlife and energy development. We participated in an Oil/Gas Mitigation Workshop held in spring 2006 and have developed innovative solutions such as yearlong drilling from a smaller number of multiple-well pads in order to reduce well pad densities and associated impacts in crucial wildlife habitat.*
- ✓ *Industry has acquired and provided to WGFD specialized equipment (e.g., Lawson aerators and a tractor) needed for habitat improvements to mitigate development impacts.*
- ✓ *Industry has funded research to assess distribution shifts and survival of mule deer in the Pinedale Anticline and Baggs area oil and gas fields.*
- ✓ *WGFD continues to diligently review each proposed lease and oil and gas development plan. The State of Wyoming is a "cooperating agency" in the Resource Management and Forest Management planning processes of the BLM and USFS, respectively. WGFD serves its mission under this "cooperating agency" umbrella by recommending measures to maintain and improve habitat conditions for mule deer and other wildlife.*
- ✓ *WGFD is a cooperating partner in the Wyoming Landscape Conservation Initiative, an interagency, interdisciplinary coordination team tasked with a long-term, science-based effort to assess and enhance habitats at a landscape scale in southwestern Wyoming while facilitating responsible development through local collaboration and partnerships.*

**Objective: Manage recreational uses to reduce their impacts on mule deer and mule deer habitat.**

***Strategy: Protect crucial winter ranges and other key areas on Commission owned lands by seasonally closing the areas to ORV use and where necessary, to all human access. Encourage similar closures on Federal and state lands.***

***Strategy: Identify areas where ORVs or other types of recreation (snow machines, skiing, antler hunting, etc.) are impacting mule deer or their habitats.***

***Strategy: Work with federal agencies to develop travel management plans that include seasonal and permanent road closures and area closures, as needed, to protect crucial winter ranges. Reduce excessive densities of open roads on transition and summer ranges. Encourage agencies to enforce their travel management plans.***

*What's been done:*

- ✓ *WGFD considers its involvement with development and revision of travel management plans a high priority on Federal and State Lands.*
- ✓ *The Wyoming Game and Fish Commission recently revised its regulations (Chapter 23) pertaining to public uses of Commission-owned lands. The regulations address travel and ORV management on Wildlife Habitat Management Areas.*

- ✓ *Travel restrictions on WGFD's hunter management and walk-in access areas are specified by regulation.*
- ✓ *WGFD, through a cooperative MOU with the Office of State Lands and Investments, has accepted responsibility for enforcing vehicle travel restrictions on State lands.*
- ✓ *Several educational articles about ORV ethics and impacts to wildlife have been printed in Wyoming Wildlife Magazine, WGFD news releases, and other media.*

**Objective: Limit the impacts of urban development and rural subdivision within mule deer habitat.**

***Strategy: Encourage land use planning statewide. Inform county and city planning and zoning boards where important mule deer habitats are located and encourage alternatives that avoid authorizing subdivisions and other developments within such areas. Encourage zoning that protects open space.***

***Strategy: During project design and permitting, work closely with private landowners and developers to minimize impacts to mule deer.***

***Strategy: Identify the key habitat areas that are most likely to be developed and attempt to protect them through conservation easements or other property interests.***

***Strategy: Continue to discourage feeding mule deer.***

***Strategy: Reduce mule deer vehicle collisions by recommending safety corridors, such as underpasses, in areas where busy highways and mule deer migration routes intersect. Review transportation plans to identify problem areas and recommend solutions.***

*What's been done:*

- ✓ *WGFD continues its involvement with city and county planning and zoning boards, encouraging them to include wildlife considerations in their plans. We have obtained exceptional cooperation from Teton County.*
- ✓ *WGFD cooperates with agencies and various land trusts such as the NRCS, The Wyoming Wildlife and Natural Resource Trust (WWNRT), The Nature Conservancy, Wyoming Stock Growers Agricultural Land Trust, Jackson Hole Land Trust, Star Valley Land Trust, and Green River Valley Land Trust to set aside open spaces for wildlife, including mule deer, through conservation easements. Landowner contacts frequently discuss conservation easements as a management tool and funding is frequently solicited by WGFD personnel to complete these projects.*
- ✓ *WGFD routinely submits comments and suggestions to city and county governments during their public involvement processes. Many of our comments recommend considerations to protect and enhance mule deer habitats.*

**Objective: Prevent the introduction or expansion of invasive plants in mule deer habitat and promote control and reduction of infestations.**

***Strategy: Map areas where non-native invasive plants threaten mule deer habitat.***

***Strategy: Promote aggressive treatment (using chemical, mechanical, biological, and grazing techniques) to eradicate non-native invasive plants.***

***Strategy: Evaluate the risk of invasive species establishment in mule deer habitats.***

***Strategy: Use multi-agency partnerships to develop coordinated approaches to identify and prioritize cheatgrass infestations and obtain funding to implement control programs.***

***Strategy: Seek legislation to list cheatgrass as a noxious weed.***

***Strategy: Encourage the legislature, NGOs, and other federal agencies to promote and secure sufficient funding to manage and control invasive species and assist private landowners.***

***Strategy: Support research to develop new and effective methods to control cheatgrass and other invasive species.***

*What's been done:*

- ✓ *WGFD participates in a number of coordinated weed management groups.*
- ✓ *WGFD applies various integrated weed management practices on all Commission owned lands.*
- ✓ *WGFD personnel are active participants in a multi-agency group seeking to address cheatgrass expansion in many parts of the State. Extensive treatments have been completed by WGFD personnel through partnerships on federal, state and private lands across Wyoming.*
- ✓ *WGFD, along with the Douglas Core Area Restoration Team, is currently evaluating trials using biological control measures.*

# Population Management

WGFD manages populations of mule deer to maintain them within the capacity of the habitat, provide recreational opportunity, and balance the diverse interests of stakeholders who include hunters (subsistence, recreational and trophy), guides and outfitters, farmers and ranchers, conservation organizations, local businesses, federal land management agencies, urban and rural property owners, and the general public. Such groups often hold diverse perspectives and may not fully recognize or understand the tradeoffs of alternative management philosophies. For these reasons, mule deer management can entail decisions that are both socially divisive and biologically complex. Attempting to meet the expectations of every group poses many challenges, so WGFD seeks to balance the diverse interests and expectations of Wyoming's citizens on a statewide basis.

Ultimately, the quality and condition of the habitat determine the maximum number of mule deer that can be sustained in a healthy herd. Some mule deer hunters believe present-day management should replicate the higher mule deer densities they recall from the 1980s, and some even refer back to the much higher mule deer populations of the 1950s and 60s. However, those eras coincided with precipitation regimes and stages of vegetation health and vigor that were more optimal for supporting productive mule deer populations. In addition, long-term intensive predator control may have allowed mule deer populations to exceed the carrying capacity of their habitat. In retrospect, many wildlife biologists believe mule deer were actually too abundant in the 1950s and 60s and that overabundance caused long-term damage to preferred forage plants. Since then, habitat conditions have declined as a consequence of fire suppression, invasive plant species, some rangeland management practices, urban sprawl, energy development, long-term drought, and historically too many mule deer. Competition for available forage between deer, elk, pronghorn and livestock can also be a limiting factor in some areas. Excessive herbivory on preferred shrubs and herbaceous species is a management concern, particularly where animals concentrate on limited winter ranges.

Chronically low fawn production, measured as the number of fawns per 100 does, is a common indication mule deer numbers may have exceeded what the habitat can support, or that habitat quantity and quality have diminished. Maintaining mule deer densities at unsustainable levels can further damage the habitat base, resulting in a less productive herd that is susceptible to large-scale die-offs from disease and severe winters. On the other hand, maximum fawn productivity may be achieved when the herd is held in check, and well within the habitat's capability. Responsible management seeks to protect the habitat by maintaining mule deer populations at sustainable levels. A productive mule deer herd in good habitat is also more resilient and capable of recovering sooner after stressful climatic events such as a severe winter.

The mule deer management program in Wyoming is based on, "Management by Objective" (Thiele 2007). Numerical population objectives have been established for the majority of

mule deer herds in the State and are reviewed every five years. Those objectives are intended to be well within the carrying capacity of the habitat under normal climatic conditions. Objectives can be adjusted after input is received from sportsmen, landowners, and land management agencies. However, since the original objectives were set, unanticipated conditions such as long-term drought, large-scale developments, habitat fragmentation, competition with other ungulates, shrub eradication programs, fire suppression, and other intensive land management practices have reduced the carrying capacity of some mule deer herds. In light of these changes, some existing herd objectives may no longer be realistic or sustainable. In these circumstances, managers focus on identifying the issues inhibiting population recovery and work with partners to correct them where possible. In some herds where the population has been chronically depressed, it may also be necessary to adjust the population objective downward.

Hunting seasons are set to manage most mule deer herds within 20% of their respective population objectives. When a population is outside this range, more liberal or conservative seasons are recommended, as needed, to reduce or increase the herd toward its objective. However, mule deer populations may be managed at a lower level to protect the herd and its habitat when the carrying capacity is depressed as a consequence of protracted drought or other environmental factors. If the factors that depress carrying capacity persist, then managers should consider adjusting the objective downward.

Sometimes, we lack adequate survey data to reliably estimate a mule deer population. WGFD has adopted alternative management objectives to address situations (such as interstate herds) in which it is impossible to generate a reliable population estimate. We also apply alternative objectives to a few herds we are unable to manage (through harvest) due to limited hunting access. Alternative objectives can be based on midwinter trend counts or landowner/hunter satisfaction surveys ($\geq$60% satisfaction level). Secondary objectives are sometimes used in conjunction with a population objective or alternative objective, and may include: habitat indices such as shrub utilization; male quality based on buck:doe ratios or antler class measurements; and harvest statistics such as hunter effort (average days required to harvest an animal) and success (percent of hunters who harvested a mule deer). Where adequate data are available, the preferred approach is always to manage harvest based on numerical population objectives (total number of mule deer in the herd, buck:doe ratio).

Mule deer population size is managed primarily through harvesting female mule deer. It is generally accepted a minimum post-hunting season ratio of 66 fawns per 100 does is required for a herd to maintain itself when there is minimal female harvest. To stabilize a productive mule deer herd (e.g., 70-80 fawns per 100 does) that is approaching its objective, an appropriate proportion of does must be harvested annually. Where mule deer are limited by their habitat, it is important to always harvest at least some females to maintain the herd at a sustainable level. Therefore, we may consider harvesting does to protect the habitat base during stressful environmental conditions (such as long term drought) even when a herd is below its population objective. When habitat conditions improve, a modest female harvest rate will not prevent the population from rebounding. On the other hand, failing to harvest

female mule deer when the population is below objective and the habitat is in poor condition may result in additional damage to the habitat and a more protracted recovery. In circumstances where mule deer population growth is inhibited by other factors such as predation, doe harvest may not be needed or desirable.

WGFD applies various harvest strategies depending on management needs. For example, the most conservative strategy is an "antlered-only" season. This allows maximum population growth when habitat conditions are optimal. However, when habitat is in poor condition, an antlered-only season can actually do more harm than good by maintaining a higher mule deer density than the habitat can support. Seasons in which a license is valid for either sex can achieve a limited harvest of does, but comparatively few hunters are willing to harvest a doe on a license that allows them to harvest an antlered mule deer. A somewhat higher doe harvest can be realized by restricting an either-sex license to does and fawns during the latter portion of the hunting season. Some hunters who were unsuccessful harvesting an antlered mule deer at the beginning of the season will opt to harvest a doe later on. Another variation is to allow harvest of either sex at the beginning of the season, and then restrict the license to antlered mule deer only during the later segment. However, WGFD has found issuing licenses valid only for doe/fawn mule deer is the most effective strategy when a significant number of female mule deer must be harvested. These licenses are always limited in quota, but are issued in sufficient numbers to achieve the necessary harvest of female mule deer. Doe/fawn mule deer licenses are sold at a lower price and may be purchased in addition to a license allowing harvest of antlered mule deer.

Some stakeholders are opposed to harvesting does and continue to believe this practice is detrimental to mule deer management in Wyoming. As a result, WGFD sometimes has difficulty implementing hunting seasons that will achieve a sufficient harvest of female mule deer to meet population management objectives, protect the habitat base, and avoid significant mortality events (i.e., "population crashes"). During the late 1980s, for example, many herds in Wyoming increased dramatically during an "irruptive" growth phase, vastly outstripping the capacity of available habitats. Although WGFD attempted to curb the undesirable population growth by harvesting additional does, those efforts often met with resistance and ultimately proved too little too late. After the winter of 1992-93 mule deer populations declined abruptly, some by more than 50%. Prescribed doe harvests during the 1991 and 1992 hunting seasons were elevated to address deteriorating habitat conditions, but were not enough to cause the observed population declines. In fact, despite efforts to increase harvest and minimize over-winter mortality, significant winter mortality was documented in many areas following the 1992-93 winter. Those declines happened because there were simply too many mule deer trying to survive on depleted habitats. Competition for available resources was excessive and most mule deer did not accumulate sufficient fat reserves before entering the winter. In many herds, the lasting effect of long-term habitat degradation continues to manifest as chronically depressed fawn recruitment and elevated winter mortality. A sustained recovery has not been attainable in many of these populations despite minimal or no doe harvest since 1992. Where habitat is determined to be a limiting

factor, it is important to evaluate the need for additional female harvest to protect the habitat base and sustain healthy mule deer herds.

Most mule deer herds in Wyoming are managed under a "recreation management" concept. Harvest is regulated to sustain between 20 and 29 bucks per 100 does measured after the hunting season has ended. In most areas, we are able to maintain buck:doe ratios within this range without limiting the numbers of hunting licenses available to resident hunters. These areas usually are open to hunting with a general license. "Recreational management" offers the maximum opportunity to hunt while providing a reasonably satisfying experience for the majority of hunters. A smaller number of mule deer herds designated as "special management" are managed to sustain between 30 and 45 bucks per 100 does after the hunting season. In order to maintain these higher proportions of bucks, harvest pressure must often be reduced either by limiting the numbers of licenses (i.e., by setting limited quota seasons), or by setting conservative hunting seasons under a general license framework. Herds managed to sustain a larger proportion of bucks do not produce as many mule deer to harvest because the proportion of does in the population is lower. Fewer does mean fewer fawns and ultimately, fewer mule deer to harvest. Consequently, hunting opportunity must be reduced both to lessen harvest pressure on bucks and to harvest a smaller surplus of mule deer. On the other hand, a mule deer population will produce a greater surplus of mule deer to harvest when the buck:doe ratio is maintained between 20 and 29 per 100 and the total population is well within the carrying capacity of the habitat. Mature bucks are available in all mule deer herds in the state regardless whether they are managed under "special" or "recreation" management.

Antler point restrictions (e.g. 3-points or more on either antler) are another harvest strategy sometimes employed to improve depressed buck:doe ratios. It may seem counterintuitive, but antler point restrictions do not necessarily produce more large bucks. When an antler point restriction is in place, the hunter is limited to harvesting only bucks with 3 points or more on either antler. Consequently, all harvest pressure is redirected to the largest mule deer in the population, which reduces their number. Since yearlings and some 2-year old bucks are protected until they become small 3-point mule deer, the overall ratio of bucks to does may increase as a result of retaining more young bucks in the population. However, harvest is merely deferred until a buck grows its first set of 3-point antlers. The maximum benefit of a 3-point season is typically realized after the season has been in place 2 or 3 years. Thereafter, the buck:doe ratio does not continue to increase and fewer bucks actually survive to grow truly large antlers. If the objective is to produce more large mule deer, the 3-point restriction needs to be lifted after 2 years so harvest is once again spread across more age classes. Should the overall buck:doe ratio again decline to an unacceptably low level, the 3-point or better season can be reinstated for another 2-3 years to augment the number of bucks in the population, and the process is repeated. Over the long-term, persistently targeting mature bucks may also eliminate desirable genetics (the ability to grow large antlers) from the population.

Overall, mule deer hunters in Wyoming continue to be satisfied with existing management and conditions, although satisfaction measures have declined somewhat since the 2006 hunter attitude survey (refer to the Public Involvement and Collaboration section). Dissatisfaction with current management direction tends to be more prevalent regionally. Even where hunters are dissatisfied, opinions differ regarding how mule deer should be managed and that further adds to the complexity and challenge of accommodating our constituents' diverse desires and expectations. In addition to the periodic statewide attitude survey, local input is solicited and strongly considered in management decisions for individual herd units or hunt areas. There is (and always will be) some interest in reducing hunter densities, despite a 52% decrease in the number of mule deer hunters since 1980. Contributing factors may include loss of access to private lands (displacing a higher *proportion* of hunters onto public lands), and lower tolerance for other hunters when fewer mule deer are seen. There is also interest in improving hunter success (active license success was 53.9% in 2014), and there is somewhat greater interest in increasing the availability of larger bucks. The 2006 survey had a question regarding opportunity tradeoffs needed to manage for larger bucks, but a similar question was not asked in the 2012 survey. That said, there appears to be a greater receptiveness for limiting resident hunting opportunity to address perceived issues of hunter crowding. However, this contradicts an even stronger desire to hunt every year, a preference for general hunting seasons, and a 60% prevalence of hunters who hunt in multiple hunt areas each year. The approach WGFD has taken is to maintain a diversity of management approaches that emphasize opportunity to hunt while providing, within reason, opportunities to hunt in special management areas where harvest of mature bucks and higher success rates are emphasized.

The following management objectives are recommended to assure productive, resilient populations of mule deer are sustained over the long term.

**Objective: Minimize the extent to which competition from other ungulates is impacting mule deer populations.**

***Strategy: Manage expanding elk populations within their established herd unit objectives.***

***Strategy: Improve our understanding of competitive interactions between mule deer and white-tailed deer, elk, pronghorn, feral horses, and domestic livestock. Develop management strategies to alleviate excessive competition and address conflicting wildlife management goals.***

<u>What's been done:</u>

- ✓ *WGFD continues to liberalize elk hunting throughout the state to hold expanding elk populations in check by increasing license allocations, issuing additional reduced price cow/calf licenses sold at a reduced price, and extending hunting seasons in some areas as late as January 31. WGFD has also negotiated several*

*hunter management areas in areas where it has been a challenge to achieve adequate harvests of cow elk.*

- ✓ *White-tailed deer management throughout the state is liberal and includes longer seasons with general license and/or limited quota license hunting through November and December. In selected hunt areas, hunters can obtain a second full-price license valid for white-tailed deer and an unlimited number of reduced-price doe/fawn licenses.*
- ✓ *WGFD funded two studies conducted by the Wyoming Cooperative Wildlife Research Unit, that examined competitive interactions between mule deer and white-tailed deer (Sawyer and Lindzey 2000), and between mule deer and elk (Porter, 1999).*

**Objective: Manage mule deer populations on a sustainable basis, within the carrying capacity of the habitat.**

***Strategy: Monitor range conditions in key habitats within winter, summer and transition ranges.***

***Strategy: Implement habitat improvement projects to restore and increase habitat carrying capacity enabling managers to sustain mule deer numbers at established population objectives.***

***Strategy: Where long-term trends in habitat conditions are irreversible (i.e., due to permanent rangeland conversions, invasive plants, climate change, subdivisions, or large-scale energy development) and have been determined to cause mule deer population declines below established objectives, lower the objective to a sustainable level.***

***Strategy: Set hunting regulations to manage mule deer populations within the established herd unit objectives. Make further adjustments based on browse utilization readings and climatic conditions, to maintain herds within the existing capacity of the habitat.***

***Strategy: Reevaluate herd unit objectives every five years and adjust them as warranted to assure the habitat is protected from overuse.***

***Strategy: Evaluate the need to reduce mule deer populations when browse utilization readings on key shrub species exceed the thresholds identified in the Mule Deer Habitat Management Guidelines (WGFD 2015) for three consecutive years based on representative sampling.***

***Strategy: Where other herbivores contribute to excessive browse utilization, advocate appropriate management actions to ensure sustainable utilization.***

*What's been done:*

- ✓ *In 2005, Wildlife Division personnel established permanent browse utilization transects in each region. Some regions had transects in place previously. These transects are read annually to assess habitat conditions and browse utilization by the existing ungulate population, and are considered in setting mule deer seasons.*
- ✓ *In the mid-1990s, Casper region developed an index to assess habitat conditions and utilization based on data from transects in Bates Hole. Some of these transects are within mule deer winter range. Mule deer populations have been managed at lower levels to reduce utilization of key shrub species that exceeded thresholds identified within the Mule Deer Habitat Management Guidelines (WGFD in review 2015).*
- ✓ *"Habitat Indices," which include browse utilization standards, have been formally adopted as secondary objectives and can be used in conjunction with the 3 primary objectives (numeric population objectives, winter trend counts, satisfaction surveys) used for managing big game populations (refer to Wildlife Division policy guidance memo dated April 10, 2013).*
- ✓ *Various strategies have been implemented in some areas to achieve harvest of female mule deer necessary to manage populations within herd objectives. These strategies include issuance of sufficient reduced price doe/fawn licenses, reduced license fees, allowance for hunters to obtain multiple doe/fawn licenses, and extended late antlerless mule deer seasons for full-price license holders. The extent to which these strategies are being implemented has decreased in recent years as many mule deer populations are currently below management objectives.*
- ✓ *The Private Lands/Public Wildlife Initiative and various hunter assistance programs have improved access to private lands, helping us to achieve desired harvest levels.*
- ✓ *WGFD has increased its emphasis on managing mule deer populations within herd objectives and within numbers the habitat can support on a sustainable basis.*
- ✓ *WGFD has increased public information and education efforts impressing the need for managing mule deer populations within the habitat's capacity and the need to harvest female mule deer to accomplish this. These efforts are accomplished through season setting meetings and publications,*

**Objective: In areas with limited access, improve hunting opportunities to realize harvest levels needed to manage populations within objective levels and to maintain productive habitat conditions.**

***Strategy: Evaluate landowner attitudes regarding hunting seasons and access.***

***Strategy: Encourage federal land trades that consolidate public and private parcels, or provide access to landlocked public lands.***

***Strategy: Increase public hunting opportunities through various landowner incentive programs, access easements, and additions/enlargements of Commission-owned lands, and by improving habitat management on private, federal, and Commission-owned lands.***

***Strategy: Increase landowner confidence and contacts by working through Wyoming Conservation Districts and WGFD personnel to achieve better access and adequate harvest on private lands.***

***Strategy: Cooperate with the Wyoming State Land Board to facilitate hunting access on State lands and to enforce travel restrictions.***

*What's been done:*

- ✓ *The Commission kicked off its "Private Lands/Public Wildlife" program (PLPW) in 2000. The program compensates private landowners for providing public access to hunt on private lands or access to landlocked public lands and is funded by voluntary contributions from sportsmen and from a portion of the Conservation Stamp revenue. Since the program began, tens of thousands of acres have been enrolled as "hunter management areas," or "walk-in areas." In 2014, the PLPW program provided access to 2,787,947 acres (1,762,342 acres of enrolled private and state lands, and 1,025,605 acres of public lands) for hunting within the boundaries of the walk-in hunting access areas and hunter management areas.*
- ✓ *Several "hunter assistance" programs are operated in the state, usually by local Chambers of Commerce, to help hunters find a place to hunt. Some WGFD regional offices and game wardens also maintain lists of landowners who are willing to accept hunters.*
- ✓ *The Commission owns and manages numerous habitat units, winter ranges, and access easements that are open to public hunting throughout the state. As opportunities arise, additional priority lands and easements may be evaluated for acquisition pending adequate funding.*
- ✓ *WGFD's regional offices periodically conduct surveys to assess landowner preferences regarding hunting seasons and hunter access. Game wardens and biologists frequently contact landowners to obtain their perspectives on these issues as well.*
- ✓ *The Legislature has included a "landowner coupon" on deer, elk, and pronghorn licenses to compensate landowners for wildlife use of private lands. The program began in 1939 and continues through the present. Hunters sign and detach the coupon upon harvesting an animal on private land and the landowner turns coupons in for payment after the hunting season.*
- ✓ *As the need arises, WGFD issues additional hunting licenses to address depredation concerns on private lands. These licenses are almost always limited to doe/fawn deer and pronghorn, or cow/calf elk only.*

- ✓ *WGFD comments on all proposals to acquire, exchange, or dispose federal lands. We encourage acquisitions and exchanges that consolidate isolated parcels of federal lands and provide access to landlocked blocks of federal lands. We also support retaining accessible public lands in federal ownership, especially those containing important habitat.*
- ✓ *WGFD obtained a policy directive from the State Land Board in 1987 affirming the public's right to hunt and fish on all state lands under grazing leases. We also coordinated with the State Land Board to obtain clarification of rules pertaining to hunting and fishing access on state lands and 2006 a brochure on this topic was published. The brochure is posted on the State Land Board website at: http://slf-web.state.wy.us/Surface/brochure.pdf.*
- ✓ *The Office of State Lands and Investments has also developed an interactive state lands access map that can be accessed at: http://onanypc.com/statelandaccess/*
- ✓ *In 2003, the Wyoming Legislature passed Enrolled Act 64, requiring the State to post signs on readily identifiable state lands that are legally accessible. The sign posting effort is ongoing.*

**Objective: Provide diverse hunting opportunities to accommodate both recreational and trophy mule deer hunters.**

***Strategy: Evaluate and consider results of mule deer hunter attitude surveys conducted at both the statewide and local levels to identify and implement hunting season frameworks and licensing systems that provide a diversity of opportunity while maintaining or improving constituent satisfaction.***

***Strategy: Maintain general license hunting seasons while providing opportunities to hunt in areas that are managed to sustain a higher proportion of mature bucks or higher harvest success.***

*What's been done:*

- ✓ *A Deer License Committee was established to evaluate problems and benefits associated with issuing separate hunting licenses for mule deer and white-tailed deer, and with potentially converting all deer hunt areas to limited quota licenses only (Sandrini et al. 2007). The report concluded, "The current system of deer license issuance adequately accommodates species-specific management of white-tailed deer and mule deer. It also provides flexibility for local big game managers to tailor seasons and opportunity for hunters to hunt both species in multiple areas on a single license." The principal recommendations that were implemented included:*
  - ➢ *All big game species license types were standardized;*
  - ➢ *A Type 3 "any" white-tailed deer license was added and hunters were allowed to obtain an issue-after Type 3 license in addition to another full-price deer license of any type. Issue-after licenses are licenses remaining in the quotas after the initial resident and nonresident license drawings.*

- *Hunters are allowed to obtain multiple Type 8 doe/fawn white-tailed deer licenses.*

**Objective: Identify and implement management actions to address agricultural damage problems.**

***Strategy: Adjust hunting regulations to alleviate agricultural damage caused by mule deer while balancing desires of hunters and landowners.***

***Strategy: Implement strategies in addition to hunting to alleviate damage.***

*What's been done:*

- ✓ *Doe/fawn licenses are issued on a routine basis to alleviate damage.*
- ✓ *In special circumstances and where justified, kill permits are issued to alleviate damage.*
- ✓ *Special seasons (depredation seasons) are set to alleviate damage within specific geographic areas.*
- ✓ *WGFD supplies free exclosure fencing to landowners experiencing deer-caused damage of haystacks.*
- ✓ *WGFD has produced several extension bulletins advising landowners and homeowners how to prevent or reduce damage by deer. In addition, WGFD provides technical assistance to landowners experiencing damage.*
- ✓ *Since 1939, WGFD has compensated landowners for damage to private property caused by big or trophy game when WGFD personnel can verify the damage and a claim is filed in accordance with state laws and Commission regulations.*
- ✓ *In 1999, WGFD published the second edition of The Handbook of Wildlife Depredation Techniques:*

*Buhler, M.L., S.H. Anderson, F.G. Lindzey, and T. Cleveland. 1999. The Handbook of Wildlife Depredation Techniques: 2nd Edition. WY Game and Fish Department, Cheyenne. 680pp.*

**Objective: Use appropriate survey techniques, within budgetary considerations, to monitor mule deer populations at a level of precision needed to assess results of harvest strategies, climatic or disease events, habitat treatments and other management or conservation actions.**

***Strategy: Evaluate monitoring and population census techniques utilized by other Western states. If alternative techniques merit consideration, identify herd units in Wyoming in which the techniques can be experimentally applied and results compared against those obtained from WGFD's traditional survey techniques.***

***Strategy: Implement the most current, effective population estimation techniques to assess mule deer population status. Standardize survey techniques statewide.***

***Strategy: Support research to monitor mule deer response to habitat treatments and other management actions.***

*What's been done:*

- ✓ *WGFD's Mule Deer Working Group (MDWG) periodically reviews current literature and contacts other state wildlife agencies to identify alternative techniques that may warrant consideration in Wyoming. Representatives from Colorado, Idaho, and Montana have attended MDWG meetings and given presentations on their states' monitoring and census procedures.*
- ✓ *Beginning in the mid 1990s, WGFD began measuring fat deposition in field-checked mule deer to assess body condition and provide an indirect means of assessing habitat quality and availability.*
- ✓ *Beginning in 1994 WGFD began conducting post hunting season change in ratio surveys and winter mortality surveys to gauge the impact of winter weather on mule deer populations in a few key mule deer herds.*
- ✓ *In 2009, 2011, and 2012, WGFD conducted aerial sightability surveys in the Platte Valley mule deer herd. These surveys provide an independent validation of estimates derived from population models. Sightability surveys are now scheduled on an approximately 5-year rotation in key mule deer herds around the state. Funding for the surveys was obtained by re-allocating a portion of existing flight budgets. WGFD and Coop Unit continues to develop a sightability model suited to Wyoming's needs.*

  *McDonald, T. L., and S. C. Amstrup. 2001. Estimation of population size using open capture-recapture models. Journal of Agricultural, Biological, and Environmental Statistics 6:206-220*

- ✓ *Continue to use quadrat sampling to estimate abundance in the Sublette Herd Unit (WEST Inc. is doing these).*

***Strategy: Conduct annual herd composition surveys to assess population status after the hunting season has ended. Surveys should cover core winter range areas after the migration period and prior to onset of winter (November/December) (Thiele 2007). A sufficient number of mule deer should be classified on the ground or from a helicopter to achieve statistically adequate sample sizes needed to reliably estimate age and sex ratios (i.e. buck:doe, fawn:doe ratios), and to provide a basis for estimating winter mortality.***

*What's been done:*

- ✓ *Annual post-hunting season age/sex composition surveys are done in most herd units.*

- ✓ *WGFD routinely checks harvested mule deer in the field and collects age/sex data.*
- ✓ *WGFD has developed standardized antler classification measurements and now collects this data from harvested mule deer and during post-season classifications in several herd units throughout the state.*

***Strategy: Continue to use spreadsheet population modeling to estimate the size of mule deer populations based on herd composition surveys, harvest and non-harvest mortality, and annual survival.***

*What's been done:*

- ✓ *WGFD relied upon POP-II modeling software to estimate mule deer population sizes beginning in the early 1980s. Other methods have been reviewed and evaluated in selected herd units.*
- ✓ *Beginning in 2013, WGFD discontinued use of POP-II and replaced it with the spreadsheet model. Considerable effort was invested, in conjunction with the Coop Unit, to develop a modeling program suited to the needs of WGFD. The guidelines are referenced below:*

  *White, G.C. and B.C. Lubow. 2002. Fitting population models to multiple sources of observed data. J. Wildl. Mgmt. 6(2):300-309.*

  *Morrison, T. 2012. User guide: spreadsheet model for ungulate population data. Appendix A-09b in S.A. Tessmann and J. Bohne (eds). Handbook of Biological Techniques: third edition. WY Game & Fish Department, Cheyenne.*

***Strategy: Continue running the big game harvest survey to estimate annual mule deer harvest, hunter success, and other statistics (Thiele 2007). Continue to estimate total harvest within a 90% confidence interval of ±10% at the herd unit level. Determine whether non-response has a significant bias effect on harvest estimates.***

*What's been done:*

- ✓ *The Statewide Wildlife and Habitat Management (SWaHM) Program and the harvest survey contractor refine and improve the harvest survey process on a continuing basis in order to achieve the contractually-specified level of precision.*
- ✓ *A non-response bias study was completed in 2003 and 2005. Results were comparable to those of an earlier study conducted in the late 1970s. The amount of bias detected at the statewide level was nominal (generally less than a few percent).*
- ✓ *During the harvest survey contract and bid process completed in 2014 considerable effort was made to evaluate and improve efficiency and data delivery*

***Strategy: Conduct post-winter mortality surveys and spring herd composition surveys to estimate fawn losses and the age and sex proportions of winter mortality estimates each year (Thiele 2007). Monitor winter survival of fawns and adults in key areas to maintain accurate indices of recruitment and survival.***

*What's been done:*

- ✓ *Winter mortality surveys and/or spring classifications are done in select herd units throughout the state.*
- ✓ *Research evaluating winter fawn survival was conducted by the Coop Unit. It was determined that due to the high cost of this work, the money is better spent on improved population estimation techniques. See above implementation of sightability surveys on key herd units.*

***Strategy: Obtain data from field-checked mule deer to monitor ages and gender of harvested mule deer, body condition, antler classification, and geographic distribution of the harvest (Thiele 2007). Collect incisor teeth to accurately age mule deer based on laboratory analysis of cementum annular deposits.***

*What's been done:*

- ✓ For many years, WGFD collected incisors from harvested mule deer to estimate the age composition of the harvest and to provide an estimate of the age structure of adult female mule deer in the population. Where such data are important to construct reliable population models, an adequate budget should be restored to collect tooth samples for laboratory aging.
- ✓ WGFD continues to collect tooth-age data in a few select herd units.
- ✓ WGFD routinely checks harvested mule deer in the field and collects age/sex data.
- ✓ In 2013, WGFD expanded efforts statewide to collect antler classification data from both harvested mule deer and mule deer observed during classification surveys.

***Strategy: Assess the comparative importance of mule deer mortalities resulting from collisions with vehicles and trains. Assess whether these mortality sources may have a significant bearing on population management.***

***Strategy: Identify and implement mitigation practices to reduce the incidence of vehicles and trains colliding with mule deer, especially at important migration crossings.***

*What's been done:*

- ✓ *WGFD helped fund the Nugget Canyon Deer Study completed in 2003.*
- ✓ *Underpass structures, deterrent devices, and motorist warning systems have been installed at Nugget Canyon, the Pinedale and Baggs areas, and other key locations around the State.*

- ✓ *In 2012, WYDOT completed 2 earthen overpass structures and 6 underpasses along a section of U.S. Highway 191 west of Pinedale to facilitate mule deer and pronghorn migrations. The deterrent devices and motorist warning systems that had been in place were determined ineffective and removed. The WYDOT also constructed high woven-wire fences to keep mule deer and pronghorn off the referenced section of U.S. Highway 191, and to guide them toward the underpasses and overpasses for safe crossings.*
- ✓ *WYDOT maintains a deer collision database to identify problem locations along the State's highways.*
- ✓ *We have developed educational materials and signs that advise motorists about dangers of wildlife collisions and encourage safe driving practices when mule deer are present.*
- ✓ *WGFD has continued to communicate with WYDOT and lobby for mule deer crossing structures at key highway crossings*

***Strategy: Continue to increase our knowledge of mule deer distribution, migration, and habitat use throughout Wyoming (Thiele 2007). Apply this information to manage mule deer more effectively, document potential impacts, justify the need for mitigation, and design more effective mitigation and habitat treatments.***

*What's been done:*

- ✓ *For many years, WGFD has mapped seasonal ranges utilized by mule deer throughout the State. The maps (geographic overlays) are often consulted to assess impacts of proposed developments. These maps have also been digitized and are available in a GIS format.*
- ✓ *WGFD developed a Decision Support System (DSS) that became operational in 2005. The DSS is a geographic data system that includes distributional data, seasonal ranges, migration corridors and other critical information. The system was devised to assist WGFD personnel, companies and consultants with analyzing potential impacts of proposed developments and identifying mitigation opportunities. All spatial data formerly associated with DSS, along with other geo-referenced data platforms, are now incorporated into WISDOM, managed by the Wyoming Geographic Information Science Center (WyGISC). WISDOM serves the same purposes as DSS, but with expanded tools and capabilities.*
- ✓ *WGFD has maintained a Wildlife Observation System (WOS) database since the late 1970s. This is WGFD's longest standing geo-referenced database containing seasonal distribution, herd composition, and mortality records for mule deer.*
- ✓ *In September, 2004 WGFD compiled "Recommendations for Development of Oil and Gas Resources within Important and Crucial Wildlife Habitats" (WGFD 2010a). This document provides management and mitigation recommendations applicable to energy developments within important habitats of several wildlife species including mule deer. It is available on WGFD's public web site. Version 6.0 incorporating results of recent research and updated impact assessment and*

*mitigation procedures was released in April, 2010. The document will continue to be periodically updated as warranted.*

- ✓ *In September, 2010 the Wyoming Game and Fish Commission approved, "Wildlife Protection Recommendations for Wind Energy Development in Wyoming" (WGFD 2010b). This document includes a brief section on big game, noting the paucity of research specific to wind energy impacts on big game. The wind energy recommendations are available on WGFD's public web site. Since the document was released, limited additional studies have been completed to assess wind energy impacts on mule deer. WEST Inc. completed an unpublished monitoring study in Oregon entitled "Elkhorn Valley Wind Project Big Game Monitoring Study," which showed displacement of elk and mule deer from a wind energy facility.* *http://www.blm.gov/pgdata/etc/medialib/blm/nv/field_offices/las_vegas_field_office/energy/searchlight_wind/supplemental_information.Par.47775.File.dat/Exhibit%2016.pdf*
- ✓ *WGFD has collaborated with the Wyoming Migration Initiative (http://migrationinitiative.org).*
- ✓ *WGFD has initiated research and partnered with the University of Wyoming Wildlife Research Unit and other investigators regarding several mule deer migration and distribution studies. These include: Uinta Herd Unit Study, Platte Valley Mule Deer Project, Wyoming Range Mule Deer Project, Sublette Mule Deer Project, Atlantic Rim Mule Deer Study, Steamboat Mule Deer Study, Baggs work, etc.*

*The following studies and baseline assessments have been recently completed in Wyoming:*


*Sawyer, H. 2007. Final Report for the Atlantic Rim Mule Deer Study. Western Ecosystems Technology, Inc., Cheyenne, WY*

*Sawyer, H., C. LeBeau, and T. Hart. 2012. Mitigating roadway impacts to migratory mule deer – a case study with underpasses and continuous fencing. Wildlife Society Bulletin 36:492-498.*

*Sawyer, H., F. Lindzey, and D. McWhirter.2005. Mule deer and pronghorn migration in western Wyoming. Wildlife Society Bulletin 33:1266-1273*

*Sawyer, H. and M. Kauffman. 2011. Stopover ecology of a migratory ungulate. Journal of Animal Ecology 80:1078-1087.*

*Sawyer, H., M. J. Kauffman, and R. M. Nielson. 2009. Influence of well pad activity on the winter habitat selection patterns of mule deer. Journal of Wildlife Management 73: 1052-1061.*

*Sawyer, H., R. Nielson, and D. Strickland. 2009. Sublette Mule Deer Study (Phase II): Final Report 2007. Western Ecosystems Technology, Inc. Cheyenne, Wyoming, USA.*

*Sawyer, H., R. Nielson, F. Lindzey, and L. McDonald. 2006. Winter habitat selection of mule deer before and during development of a natural gas field. Journal of Wildlife Management 70:396-403*

*Webb, S.L., M.R. Dzialak, K.L. Kosciuch, and J.B. Winstead. 2013. Winter resource selection by mule deer on the Wyoming-Colorado border prior to wind energy development. Rangeland Ecology & Management. 66(4):419-427.*

*Webb, S.L. and M.R. Dzialak, D. Houchen, K.L. Kosciuch, and J.B. Winstead. Spatial ecology of female mule deer in an area proposed for wind energy development. Western North American Naturalist 73(3):347-356.*

*Young, D., and H. Sawyer. 2006. Wildlife Crossing Study: US Highway 287/26, Moran Junction – Dubois. Western Ecosystems Technology, Inc., Cheyenne, WY*

- ✓ *In 2011, the MDWG of the WAFWA published, "Energy Development Guidelines for Mule Deer." This document addresses issues and concerns related to energy development in the West, and provides guidelines for project planning, design, and mitigation to avoid and reduce impacts to mule deer. The document can be downloaded online at: http://www.muledeerworkinggroup.com/Docs/Energy_Development_Guidelines_for_Mule_Deer_2013.pdf*

*Lutz, D.W., J.R. Heffelfinger, S.A. Tessmann, R.S. Gamo, S. Siegel. 2011. Energy development guidelines for mule deer. Mule Deer Working Group, Western Association of Fish and Wildlife Agencies. 27pp.*

**Objective: Continue to refine and improve herd unit boundaries and concepts for managing populations of mule deer (Thiele 2007).**

***Strategy: Conduct studies of mule deer distribution and movements to refine seasonal range type delineations and herd unit boundaries. Revise herd unit boundaries and combine herd units as needed to meet the criterion of not more than 10% interchange between adjoining herd units.***

***Strategy: For those herds shared with adjacent states, continue to improve coordination and data collection in order to attain better population and harvest estimates, and more reliable trend monitoring.***

***Strategy: Coordinate with wildlife agencies in neighboring states to cooperatively manage mule deer populations and to share management techniques and strategies.***

*What's been done:*

- ✓ *WGFD continues to conduct population movement studies where existing herd unit boundaries are in question. Most recently, the Steamboat Herd was combined with, and incorporated into the Sublette Herd due to migration and interchange between the two former herds.*
- ✓ *WGFD conducts surveys during critical periods to document seasonal habitat use and distribution.*
- ✓ *WGFD coordinates data collection with adjoining states.*
- ✓ *Local wildlife managers commonly work with their counterparts in adjacent states on many issues affecting mule deer management.*
- ✓ *WGFD entered into a "good neighbor" agreement to cooperatively manage interstate wildlife populations (Memorandum of Agreement on the Management of the Multi-state Wildlife Resources in Boundary Habitats of Colorado, Idaho, Montana, Utah and Wyoming).*

**Objective: Assess the effect of hunting on the various age/sex classes of mule deer.**

***Strategy: Determine age and sex-specific mortality rates during hunting seasons.***

***Strategy: Compare data obtained from harvest field checks and the harvest survey to determine prevalence of age or sex reporting biases in the harvest survey and to estimate their importance.***

*What's been done:*

- ✓ *WGFD collects incisors from hunter-harvested mule deer to determine age structure of antlered mule deer harvested in selected herd units.*
- ✓ *Mortality surveys are done each spring in western Wyoming to gauge overwinter mortality of mule deer and collect incisors to determine age structure of winter mortality.*

# Predator Management

Many predators such as coyotes, mountain lions, wolves, bobcats, bears, and eagles prey on mule deer. Ballard et al. (2001) provided a review and synthesis of research on deer-predator relationships, which formed the basis for the chapter on deer-predator relationships in "Mule Deer Conservation: Issues and Management Stategies" (deVos et al. 2003), and the context for the discussion on predation in the "North American Mule Deer Conservation Plan" (Mule Deer Working Group 2004). Predator management includes those actions directed primarily at managing predator populations to reduce the effects of predation on mule deer. Hurley and others (2011) published a comprehensive evaluation of mule deer population response to coyote and mountain lion control efforts in Idaho. The afore-mentioned documents were instrumental in synthesizing information for this section.

Relationships between predator and prey populations, habitat variables, and weather events are dynamic and complex. The extent to which predators affect mule deer populations varies with the circumstances surrounding each mule deer herd at any particular time and can also vary year to year, depending to a great extent on the size of a mule deer population in relation to the habitat's carrying capacity. Mule deer populations are impacted by variables such as changes in habitat quality and quantity, weather patterns (prolonged drought or severe winters), competition with other ungulates for forage, species and densities of predators, effects of hunting season strategies, and abundance of alternate prey. Managers must consider all of these factors in determining whether predator management is an appropriate and effective solution, and if so, in prescribing effective management strategies.

Predator management may or may not increase the size of a mule deer population. For example, a mule deer population near the habitat's carrying capacity will not respond, in a sustainable manner, to predator management. Habitat carrying capacity is difficult to determine and varies from season to season and year to year. However, several indices may indirectly indicate carrying capacity has been exceeded. For example, adults in poor body condition, low birth rates, low fawn production, high utilization of available forage, and high population densities all suggest a mule deer population has surpassed the capacity of the habitat to support a growing mule deer herd. In these circumstances, predator management to decrease mule deer predation will not be desirable or effective.

A mule deer population that is chronically depressed may respond to predator management when fawn production and adult mule deer body condition are good, but fawn recruitment and adult survival are low in otherwise favorable habitat (i.e., a "predation sink") (Jenks 2011), provided control actions are sufficient and target the predator(s) limiting the mule deer population. Predator reduction efforts that do not adhere to these qualifications often fail to increase mule deer populations. Hurley et al. (2011) demonstrated decreasing mountain lion populations resulted in increased doe:fawn ratios, adult doe survival, and a slight increase in the mule deer population, but only temporarily. They also found a decrease in the number of coyotes resulted in increased fawn survival through summer, but did not increase fawn

recruitment into the population. Hurley et al. (2011) concluded neither mountain lion nor coyote reductions altered the overall direction of a mule deer population's trajectory. Similarly, Pierce (2012) concluded mountain lion reductions did not change mule deer population trend. Under specific circumstances, a reduction of predator populations may be warranted to attain management goals within an individual herd unit. However, it is imperative to measure the relationship between predator reduction and ungulate population response to determine if predator control efforts are effective in each circumstance.

It has been shown predator management may be beneficial to mule deer when:

1. Predation is a documented factor limiting growth of a mule deer population;
2. The mule deer population is well below the habitat's carrying capacity;
3. Populations of alternate prey species (for example rodents and rabbits) are at low levels;
4. Management actions target the predator species actually limiting the population;
5. Management efforts can realize a sufficient reduction in predator densities to yield results;
6. Predator management is conducted at a time of year when it is most effective;
7. Predator management is focused in small areas of habitat critical to mule deer; and
8. Management efforts can be sustained over a period of years to keep the predator population sufficiently in check.

The Wyoming Animal Damage Management Program was created by the Wyoming Legislature in 1999 and is administered by a 15 member board, commonly referred to as the Animal Damage Management Board (ADMB). The ADMB was established for the purpose of mitigating damage caused to livestock, wildlife and crops by predatory animals, predacious birds and depredating animals or for the protection of human health and safety. The ADMB distributes funding to county Predator Management Districts and approved projects to implement predator management strategies in conformance with the ADMB's mission.

Commission Policy VIIR (September 8, 2006) stipulates predator (coyote) control may be considered to increase mule deer recruitment and/or survival, if post-hunting season fawn:doe ratios are less than 65:100, or after sudden population losses (winter die-off) greater than 25%. Control actions may also be considered when productivity and fawn survival data are not available, and the population is more than 15% below the objective level. The need for predator management should be objectively evaluated and should consider whether other natural factors may also be influencing mule deer productivity and population trends. Studies are encouraged to assess the effectiveness of predator management actions.

The strategies outlined below are intended to address the major predators, including trophy game animals (i.e., mountain lions and black bears) that prey on mule deer. Mountain lions and black bears are managed under plans approved by the Wyoming Game and Fish

Commission. If predation by trophy game animals is documented to have population level impacts on mule deer, management objectives for trophy game animals can be reevaluated.

**Objective: Implement predator management to maintain or increase mule deer populations when predation is determined the cause of a population decline or is suppressing population recovery.**

***Strategy: Predator management intended to increase mule deer recruitment and survival should be considered only if it is determined predation is suppressing population growth <u>and</u> if habitat conditions are sufficient to support a higher mule deer population.***

***Strategy: In herds that are below carrying capacity, identify important parturition areas for mule deer. Annually direct Wildlife Services and county Predator Management Districts to focus coyote control actions from February through July within those areas.***

***Strategy: If herds are depressed below objective and the habitat's carrying capacity, and if predation is the primary factor limiting population growth (i.e., fawn production and adult mule deer body condition are good but fawn recruitment and adult survival is low), undertake actions to reduce predator or trophy game populations.***

***Strategy: Predator management is not recommended to support additional growth of any mule deer herd that is over the Commission's approved population objective, or within any hunt area that is over the desired population level.***

***Strategy: Predator management is not recommended in areas with chronic damage caused by mule deer.***

***Strategy: Predator management is not recommended in areas where WGFD has limited opportunity to control the mule deer population through hunting.***

*<u>What's been done:</u>*

- ✓ *The Wyoming Game and Fish Commission contributes $100,000 annually to the Animal Damage Management Board for predator control in areas where predation is thought to limit the size of desired wildlife populations. In recent years coyote control, primarily through aerial gunning, fumigating dens, and trapping, has been undertaken in areas of exceptionally depressed fawn recruitment. As a general rule, habitat conditions rather than predation limit fawn survival. In light of this reality, WGFD has not undertaken broad scale predator control. To make the most effective use of available funding, WGFD*

*focuses control actions in localized areas where actions may have some beneficial effect.*

- ✓ *Mountain lion management throughout most of the state is driven by public perception and by increasing lion densities. Harvest mortality limits have been liberalized in most lion hunt areas over the past 15 years. In most situations it is unclear if the higher lion harvests have actually decreased predation on mule deer and whether mule deer populations have responded. WGFD is currently evaluating relationships between increased harvest of mountain lions and mule deer populations in many areas of the state. Increased surveillance and possibly more detailed studies will be necessary to understand the relationship between lion harvest and mule deer population response. Lion harvest quotas have been increased specifically to address depressed mule deer numbers in hunt areas such as the Black Hills and Platte Valley.*
- ✓ *In response to public concerns about mule deer populations in the Wyoming Range, black bear mortality limits in the Greys River hunt areas were increased significantly for the 2014 – 2016 harvest cycle. The increase coincides with an ongoing study of mule deer neonate mortality beginning in the spring of 2015. The study will provide invaluable information regarding effects of black bear predation on mule deer.*
- ✓ *WGFD has coordinated with the Coop Unit to conduct research addressing mule deer habitat, nutrition, productivity, and survival in the Wyoming Range. Results documenting cause-specific mortality of ungulates will greatly enhance our knowledge of the potential impacts of predation on herds of interest.*

**Objective: Maintain a dialogue and ongoing information exchange between WGFD, the ADMB, county Predator Management Districts, and the public with regard to predator management issues.**

***Strategy: Coordinate with the ADMB and county Predator Management Districts to implement predator management where appropriate and in accordance with Wyoming Game and Fish Commission Policy VIIR.***

***Strategy: Disseminate information through public forums, reports, research findings, and peer-reviewed publications to explain and support WGFD's decisions and actions regarding predator management strategies.***

***Strategy: Clearly convey the Commission's rationale for its Policy on Predatory Animal and Predacious Bird Management Recommendations for the Benefit of Wildlife.***

*What's been done:*

- ✓ *Through legislative appropriation to the ADMB, money has been made available to qualifying predator management districts for the purpose of addressing*

*predatory animal impacts to wildlife including mule deer. WGFD coordinates with the ADMB and Predator Management Districts to guide their predator management efforts to maximize benefits for mule deer.*

- ✓ *WGFD has coordinated with the ADMB regarding projects to assess population dynamics and identify seasonal ranges in the Platte Valley, Cedar Mountain and the Wyoming Range Herd Units. In one herd, that coordination also included predator management actions to improve fawn recruitment.*

**Objective: Address information gaps in our understanding of the interactions between mule deer, other ungulates, and predators.**

***Strategy: Conduct research to determine if predation is limiting mule deer populations under differing environmental and ecological conditions. Studies should include herds across a range of vital rates (i.e., fawn recruitment and mortality rates) and habitat types to determine if predator control is an appropriate and effective management tool. Effects of climatic factors, habitat quality, and competition should also be considered.***

***Strategy: Evaluate the effectiveness of predator control actions for increasing recruitment and survival, taking into account environmental influences on fawn ratios and populations.***

*What's been done:*

- ✓ *WGFD has coordinated with the Coop Unit to conduct research projects addressing mule deer habitat, nutrition, productivity, and survival in the Wyoming Range herd. Results documenting cause-specific mortality of ungulates will greatly enhance our knowledge of the potential impacts of predation on herds of interest.*

# Diseases

Diseases and parasites serve essential functions in the ecology of all wildlife and have been a normal part of the life cycle of mule deer for as long as mule deer have existed. Disease is an environmental factor that can naturally regulate mule deer populations and assure the fittest animals survive. The ultimate effect on a population depends on a variety of factors related to the host organism (mule deer), the specific pathogen, and other environmental factors. Factors related to the host can include the density and age structure of the population, general health or physical condition of animals in the population, degree of interchange between herds, and whether the animals have been previously exposed to the disease (animals that survived a prior outbreak often develop a degree of immunity). Pathogen factors include the specific type of disease, mode of transmission, virulence, and whether the pathogen is new to a population or enzootic (always present at some level). Important environmental factors can include the condition of the range or forage, other nutritional parameters, distribution of water sources, and stressors such as drought, extreme cold, or heavy snow.

In general, most diseases of mule deer are believed to have little effect at the population level. However, the consequences of disease are difficult to study because sick mule deer are not easily detected unless they die in large numbers or in areas where the carcasses are easily observed. Sick animals tend to seek seclusion, are more prone to predation, are eaten by scavengers, or decompose soon after they die. Managers and researchers typically locate only a few individuals during a die-off and in most cases only large die-offs are studied. Rigorous studies of diseases, based on statistically adequate samples, are difficult to undertake and cannot be done within current agency budgets. In addition, clinical signs of many diseases are often similar and make field diagnosis difficult. In most cases a veterinary laboratory is several hours away, so it can also be difficult to obtain clinical diagnoses by properly trained personnel. Some of the more important diseases affecting mule deer populations in Wyoming are described below.

Epizootic hemorrhagic disease (EHD) and bluetongue are closely related viral diseases that can limit populations locally or regionally. Viruses causing the two diseases are transmitted by the same biting midges. The two diseases produce indistinguishable symptoms in deer and pronghorn. Outbreaks typically happen in late summer or early fall and are most severe in wet years when the first frost is delayed, and in dry years when animals concentrate around stagnant water sources. These conditions enable the biting midges that spread the diseases to become more prevalent and live later into the fall. There are multiple strains of the virus, and two forms of the disease. The acute form kills or sickens large numbers of deer over a comparatively short period. Symptoms include edema (swollen tissues) and hemorrhages throughout the body. Infected deer are commonly found sick or dead at water sources, often exhibiting respiratory distress, excessive salivation or drooling, loss of awareness of their surroundings, and sometimes swollen tongues or eyelids. The chronic form does not result in large-scale die-offs; however, emaciated deer are found (or sometimes

shot during hunting season) with lesions in their mouths, rumen, and on their hoofs. A confirmed diagnosis requires laboratory analysis of tissue samples to identify the virus.

Deer adenovirus is an emerging disease in Wyoming. This disease has been diagnosed in moose in Canada and Wyoming, in mule deer in Oregon, Washington, California, and Wyoming, and in white-tailed deer in Idaho and Iowa. Adenovirus was the cause of a hemorrhagic disease that caused high mortality in mule deer in central and northern California in 1993 and 1994. Over a thousand mule deer died during this outbreak. Infected animals develop systemic disease resulting in swelling and/or fluid accumulation in the lungs, bloody diarrhea, and/or localized infection with lesions in the mouth and rumen.

Chronic wasting disease (CWD) is caused by a protein particle called a prion, which can transform normal proteins into an abnormal form. All members of the deer family (mule deer, white-tailed deer, elk, and moose) are susceptible, although to this point in time, the disease has been most prevalent in mule deer and white-tailed deer. CWD affects the central nervous system, eventually leading to abnormal behavior, weight loss or emaciation, excessive salivation, droopy ears, hair-loss, and ultimately death in all infected animals. Infected deer are often found near water sources and are usually unaware of their surroundings, leaving them more susceptible to predation. CWD has been present at least four decades in southeast Wyoming and continues to spread into other regions, albeit fairly slowly. Based on recent research, a degree of genetic resistance to CWD has been documented in mule deer, white-tailed deer and elk populations. Individuals with certain genotypes are somewhat more resistant to initial infection and tend to live much longer post-infection (Jewell et al. 2005). The differential infection rates and post-infection survival times infer some potential for long-term genetic selection that may reduce the population-level impact of CWD infection. However, the disease remains ultimately fatal to all cervid species.

Pasteurellosis is a comparatively rare bacterial disease known to infect mule deer in Wyoming. The disease can cause various symptoms including pneumonia, hemorrhagic septicemia, arthritis, meningitis, and mastitis. Onset is often rapid and infected animals usually die after a short time. The pneumonia form is most prevalent in wild deer.

Pink-eye, (keratoconjunctivitis) is an inflammation of the conjunctiva and cornea of one or both eyes. Symptoms include reddened, swollen eyes or eyelids, often with mucoid or pus-like discharge, and sometimes cloudiness of the cornea. Pink-eye is fairly common, often recurs in the same locations winter after winter, and can be caused by numerous different bacteria and viruses. This disease tends to be more prevalent in dense deer populations or where deer are concentrated. One potential cause of pink-eye that warrants special mention is plague or infection with the bacterium *Yersinia pestis*. Several cases of pink-eye have been associated with plague-infested areas over the past several years. In most of these cases, the deer also had plague bacteria in other tissues (lung, liver, and lymph nodes) and were very sick or dead when found. This type of pink-eye poses a serious risk to human health and appropriate precautions should be taken to prevent infection from handling sick or

dead deer. The impact of pink-eye at the population level is unknown, but over the past decade there have been several documented cases in which multiple mule deer mortalities have resulted from pink-eye infections in various locations around the state.

Chewing lice infestation (pediculosis) also occurs in mule deer, but currently is not considered a population limiting factor in Wyoming. Chewing lice *(Bovicola tibialis)* were first discovered in Carbon County in 2009, but have since been detected elsewhere in Wyoming. The same species of chewing lice has significantly impacted deer fawns in Washington State (Mertins 2011). The frequency and distribution of mule deer carrying high parasite loads of chewing louse is unknown in Wyoming. Exotic pediculosis has been diagnosed in free-ranging deer from several states adjacent to Wyoming, including South Dakota, Nebraska, and Idaho (Mertins 2011). Surveillance for chewing lice should continue in Wyoming to the extent feasible.

Mule deer co-evolved with many endemic diseases that are for the most part not considered a substantial threat at the population level. From a management standpoint, the threat of introducing new diseases has much more serious implications. As game ranching, private ownership, transportation and trade of wildlife continue to grow around the world, new and emerging diseases will potentially pose significant jeopardy to mule deer and other wildlife. Feeding mule deer poses a particular risk, because it artificially concentrates animals and elevates the risk of disease transmission. Equally, it is very important to maintain and enforce current regulations controlling the transportation and importation of deer and elk carcasses to reduce the risk of disease transmission to new areas. Our priorities should include effective monitoring and surveillance, research on the distribution, transmission and effects of known diseases, and control and prevention of spread of new diseases. A major goal of wildlife agencies is to assure diseases and parasites do not unnaturally limit mule deer populations.

**Objective: Monitor the distribution and effects of known diseases affecting mule deer (i.e., CWD, EHD).**

***Strategy: Continue to monitor and manage CWD in accordance with WGFD's CWD plan.***

*What's been done:*

- ✓ *WGFD has sampled and tested 51,799 deer, elk and moose from 1997 to 2014.*
- ✓ *WGFD maintains a GIS database depicting the distribution and prevalence of CWD positive deer.*
- ✓ *WGFD remains involved in research projects on CWD to:*
  - ➢ *Estimate whether CWD affects white-tailed deer use of various habitats and their interaction with cattle.*

- *Better understand the epidemiology of CWD in free-ranging mule deer and white-tailed deer in the northern Laramie Range (both are PhD-level research projects through the University of Wyoming).*
- *Determine how the infectious agent of CWD may be transmitted among mule deer and elk. Currently, several samples such as feces, urine, blood, and saliva are collected from infected elk held in metabolic cages. These biological samples are analyzed at the University of Wyoming for the presence of CWD.*
- *Develop a CWD tissue bank where CWD-infected mule deer, white-tailed deer, and elk are euthanized periodically and multiple tissues harvested. These tissues will be distributed worldwide to other investigators who are conducting a variety of research on chronic wasting disease.*
- *Model the effects of long-term exposure to CWD. Captive elk were exposed to the CWD infectious agents, both from other infected elk and through the environment. The purpose of this study was to determine how long elk will survive in an environment with maximum exposure to chronic wasting disease. A model incorporating reproduction and other mortality factors was developed to estimate the effect of CWD on a free-ranging elk population. The model predicted a long-term genetic shift toward a more favorable genotype that better resists CWD infection and increases survival time post-infection.*
- *WGFD's Veterinary Services Branch is currently researching the efficacy of a CWD vaccine.*

***Strategy: Continue routine monitoring of other diseases and parasites, collect specimens and samples for analysis.***

*What's been done:*

- ✓ *WGFD routinely collects tissue samples from deer that appear sick or are suspected to have died from disease. Samples are sent to the WGFD's Wildlife Disease Lab for analysis.*

***Strategy: As appropriate, adjust hunting seasons in response to large-scale disease outbreaks and die-offs.***

*What's been done:*

- ✓ *When WGFD becomes aware of large-scale mortality events, we consider adjusting hunting frameworks in order to account for the loss of animals to disease and other factors.*

***Strategy: Provide training to assist field personnel with detecting and identifying diseases and parasites, and with surveillance, monitoring, management, necropsy and tissue sampling procedures.***

*What's been done:*

- ✓ *WGFD provides appropriate training when specific needs arise to monitor diseases. For example, we conduct workshops each year to train personnel how to collect and handle tissue samples for CWD testing. We have also provided training on brucellosis and EHD surveillance and testing.*
- ✓ *WGFD has produced the following publications on identification and pathology of wildlife diseases in Wyoming:*

  *Kreeger, T.J., T. Cornish, T.E. Creekmore, W.H. Edwards, and C. Tate. 2011. Field Guide to Diseases of Wyoming Wildlife. Wyoming Game and Fish Department, Cheyenne. 218pp.*

  *Thorne, E.T., N. Kingston, W.R. Jolley, and R.C. Bergstrom (eds). 1982. Diseases of Wildlife in Wyoming. Wyoming Game and Fish Department, Cheyenne. 353pp.*

- ✓ *WGFD has also provided personnel with copies of the following publication:*

  *Friend, M., J. Christian, and E.A. Ciganovich (eds). 1999. Field Manual of Wildlife Diseases. U.S. Geological Survey Information and Technology Report 1999-001. Washington, D.C. 426pp.*

**Objective: Reduce the risk and incidence of non-endemic parasites and diseases.**

***Strategy: Regulate the import, export, and transportation of deer and elk carcasses from known CWD areas.***

*What's been done:*

- ✓ *The Commission adopted regulations restricting transportation of big game carcasses within and from known CWD areas both inside and outside Wyoming.*

***Strategy: Regulate wildlife transportation and prohibit game ranching***

*What's been done:*

- ✓ *Transportation and possession of wildlife are regulated under Chapter 10 of the Wyoming Game and Fish Commission's regulations.*
- ✓ *Private ownership of big game has been prohibited in Wyoming since 1973. Game ranching is also prohibited. WGFD will steadfastly oppose efforts to legalize game ranching because this commercial activity poses grave and irretrievable risks to the State's native wildlife. Elsewhere, game ranching has had devastating impacts as a consequence of disease transmission, hybridization, competition and habitat destruction by escaped nonnative species.*

***Strategy: Discourage feeding of mule deer.***

*What's been done:*

- ✓ *WGFD has published several popular articles and press releases informing the public about problems created by feeding big game. These articles are periodically re-released.*

***Strategy: Manage mule deer populations at healthy levels that can be sustained by existing habitat conditions.***

*What's been done:*

- ✓ *WGFD attempts to manage mule deer herds within established population objectives. The objectives account for the habitat's carrying capacity and are adjusted when necessary.*

# Law Enforcement

Wildlife laws and regulations serve three fundamental purposes: 1) protect the resource; 2) protect the public; and 3) assure equitable opportunity to enjoy the resource. A strong majority of the hunting and non-hunting publics support effective wildlife laws that are firmly and fairly enforced. Due to the rapid evolution of outdoor technology, increasing numbers of users, and increasing trophy values, wildlife law enforcement remains as important today as it was during the early years of the conservation movement.

Several important functions of law enforcement related to mule deer management and conservation include:

1) Maintain an effective system of mule deer management. Perhaps the most important role of law enforcement is to secure our ability to regulate harvest within prescribed, biological limits. The institution of law enforcement and its field presence assure the majority of hunters comply with statutes and regulations designed to manage harvests within sustainable levels.
2) Detect and reduce illegal harvest or poaching of mule deer. Mule deer are especially vulnerable during the rut and in winter when they congregate on traditional wintering areas. While poaching impacts both does and bucks of all age classes, most illegal hunting targets mature bucks and removes genetically superior animals from the population. This loss can impact the quality of bucks in future generations of mule deer. Significant poaching activity could reduce the number and quality of bucks available for harvest by law-abiding sportsmen in subsequent years.
3) Enforce laws and regulations on Commission owned lands and State lands to minimize disturbances to mule deer. Coordinate with federal land management agencies to regulate and enforce off-road vehicle (ORV) use and recreational activity within sensitive habitats (e.g. crucial winter ranges). Mule deer are negatively impacted by heavy off-road vehicle use and high levels of dispersed recreation on winter ranges. Impacts can include added stress to mule deer and displacement from preferred habitats, resource damage, and illegal access to designated wilderness areas or to areas seasonally closed to recreational activity to protect wildlife and other resources. Many hunters concerned about the problems ORV abuse cause are increasingly urging WGFD to establish and enforce ORV travel restrictions during deer hunting seasons.
4) Enhance public support and recognition of wildlife laws. Support for WGFD originates at the local level. Through contacts and our presence in local communities, enforcement personnel foster greater understanding of wildlife laws and public support in enforcing them.
5) Regulate possession and transportation of wildlife to avoid or limit disease transmission and potential for hybridization with native wildlife. WGFD also regulates disposal of harvested deer and elk from CWD areas.

**Objective: Increase compliance with wildlife laws designed to protect mule deer populations and habitats.**

***Strategy: Work with federal land management agencies to enforce travel management and seasonal closures on federal lands.***

***Strategy: Enforce laws and regulations on Commission-owned and State lands.***

***Strategy: Make educational materials, including ORV rules and regulations, more accessible to the public via brochure dissemination and on WGFD website.***

*What's been done:*

- ✓ *WGFD enforces travel management rules and seasonal closures on Commission-owned lands to minimize disturbances to mule deer.*
- ✓ *On some USFS and BLM lands, WGFD has entered cooperative agreements closing important winter ranges to human and vehicular access.*
- ✓ *Through periodic consultation and coordination, WGFD encourages the USFS and BLM to implement travel management plans and increase enforcement of existing travel restrictions on public lands.*
- ✓ *WGFD has entered into a memorandum of understanding with the State Land Board, enabling WGFD to enforce illegal off-road travel, camping, and fires statewide and antler hunting west of the Continental Divide (per state statute and regulation) on State lands.*

***Strategy: Implement programs to protect mule deer when they are most vulnerable to harassment and illegal take, especially on winter ranges. Publicize high profile enforcement cases that are successfully prosecuted.***

*What's been done:*

- ✓ *WGFD has implemented travel and access management plans, road closures, winter range closures, and motorized travel limitations on Commission owned lands. We encourage federal agencies to institute similar closures and restrictions within important habitats on federal lands to protect mule deer during critical times of year.*
- ✓ *WGFD worked with the Legislature to promulgate a law regulating the collection of shed antlers to limit disturbance to wintering big game animals on all public lands west of the Continental Divide.*
- ✓ *The **Stop Poaching** program is a joint effort between WGFD and the Wyoming Wildlife Protectors' Association. The program pays a reward to persons who report information leading to the arrest and conviction of wildlife violators. The **Stop Poaching** enhancement program procures billboards, hats, knives, bumper stickers, calendars and brochures used to inform the public. A **Stop Poaching** slide show is presented at hunter safety classes to illustrate the cost of ignoring poaching activities. "Wildlife Crime: Stories from Wyoming's wildlife officers"*

*was published in 2013 and is a sought after publication depicting true life accounts from the files of game wardens and wildlife investigators statewide. The series, based on investigations and prosecutions of resource abusers, encourages the public to support wildlife law enforcement and assist WGFD through the* ***Stop Poaching*** *program.*

- ✓ *WGFD developed a computerized licensing system to more easily detect license fraud. This system is used frequently within Wyoming and is shared with investigators from other states.*

***Strategy: Conduct and improve operations to apprehend poachers and continue to develop more sophisticated enforcement technologies.***

***Strategy: Maintain a sufficient enforcement presence to attain a high level of compliance with wildlife laws and to deter illegal activity.***

*What's been done:*

- ✓ *WGFD utilizes task forces to detect poaching activities. Officers from warden districts around the state are assembled to serve on these task forces. Although catching violators often requires substantial time in the field, the public strongly supports these types of operations because they resolve high profile cases involving illegal take of trophy mule deer. Perhaps the greatest benefit is the publicity value, which serves as a strong deterrent to others who may contemplate similar crimes.*
- ✓ *WGFD's Forensics and Fish Health Laboratory at the University of Wyoming analyzes forensic evidence such as hair, blood, bone, feathers, meat, tracks, saw marks, ballistics, or photographs. This essential service assists WGFD in resolving many wildlife crimes each year. One noteworthy development in recent years is the use of DNA evidence to link the perpetrator to a crime scene. Wildlife forensic science pioneered the application of DNA technology for this purpose.*
- ✓ *WGFD created a Wildlife Investigative Unit in 1996. These officers primarily focus on complex and long-term investigations. They assist regional wardens by taking on more time-consuming, in-depth investigations necessary to successfully prosecute cases involving multiple offenders, illegal commercial activities, multiple jurisdictions, or other complex circumstances.*
- ✓ *The Investigative Unit coordinates with USFWS to address interstate movement of illegally taken mule deer.*

***Strategy: Work with the public, prosecutors, judges, and legislators to build support for adequate fines and penalties and for stronger laws to provide an effective deterrent.***

*What's been done:*

- ✓ *The Wyoming legislature promulgated a law commonly known as the "winter range statute," which substantially stiffened the penalties for illegal take of*

*antlered or horned big game animals without a proper license or during a closed season. Those found in violation may be fined up to $10,000, imprisoned up to one year, or both.*

- ✓ *A forfeiture statute was also promulgated enabling the court to seize devices and equipment including firearms, ammunition, traps, snares, vessels, motorized vehicles, and aircraft used to aid in the illegal take of wildlife prosecuted under the winter range statute.*
- ✓ *Wyoming statute was amended to make it illegal for anyone to possess wildlife taken illegally in another state, as well as to possess any part from a big game animal that was allowed to needlessly go to waste.*
- ✓ *Wyoming statutes grant the Commission authority to establish by rule and regulation restitution values of wildlife, which the courts consider in assessing fines and penalties. The restitution value of a mule deer is currently $4,000.*
- ✓ *The legislature promulgated a statute allowing wildlife officers to deploy decoys that simulate wildlife and to charge persons who attempt to take simulated wildlife in violation of game and fish laws. Mule deer decoys are frequently used to detect violations such as shooting from a road, hunting without the proper license, hunting in the wrong area, hunting in a closed area, and so forth.*
- ✓ *Wyoming, along with 43 other states, is a member of the Wildlife Violator Compact. Signatory states recognize and enforce court-ordered revocations of hunting, fishing and trapping privileges regardless which member state prosecuted the violation(s).*

# Weather

Weather events and long-term climatic trends can affect mule deer directly and indirectly. During severe winters, deep or crusted snow restricts mule deer movements and access to forage. Exceptionally cold weather also increases metabolic stress. Drought compromises the ability of mule deer to recover or maintain satisfactory body condition. Drought preceding severe winters exacerbates the negative effect of adverse weather. These conditions can exhaust fat reserves, leading to malnutrition and higher mortality. Fawns are especially vulnerable to high mortality rates in winter and adults can be susceptible when they are in poor condition. In addition, fawn survival is often lower following a severe winter because nutritionally stressed does give birth to fawns in poor condition and have a reduced ability to provide adequate nutrition (milk) for newborns. Some exceptional winters are so severe that significant mortality will occur regardless of the condition of mule deer or their habitat.

Seasonal precipitation patterns strongly influence the quantity and quality of forage available to mule deer, which in turn affects the overall health and productivity of a herd. Precipitation received in the months of April, May and June directly influence shrub annual leader production and overall forage quantity on many winter ranges. During years of favorable moisture, plant growth, the availability of preferred plants, and nutritional content of forage improve. Under these conditions, mule deer are able to recover more quickly from the prior winter and accumulate ample fat reserves through the summer and fall. Mule deer in good quality habitat typically have higher reproductive and survival rates, and their fawns grow more quickly. Does also tend to bear twins and produce sufficient milk to raise healthy fawns that are less susceptible to predation and disease. Fawns that grow to a larger size by fall also have a better chance of surviving their first winter.

Mule deer have adapted to a variety of rangeland, forest, and agricultural environments ranging from low to high elevations and southerly to northerly latitudes, including regions heavily modified by land use changes. The effects of weather and climate can vary markedly among these environments. For example, drought tends to have a more pronounced impact on mule deer inhabiting rangelands and agricultural regions at lower elevations. On the other hand, severe winters can be a more significant factor in mountainous environments where mule deer have dependable access to succulent forage in the summer, but are exposed to harsher winter conditions.

Our understanding of how mule deer populations are affected by the complex interactions among weather and other environmental factors is incomplete. The number of mule deer that die during winter can be influenced by their nutritional status in the fall, the sequence and timing of winter storms, depth and duration of snow cover, crust formation, duration of cold temperatures, and quality of forage on winter ranges. Influence of weather can be modified by combinations of these environmental conditions. For example, mule deer in good nutritional status at the beginning of the winter can withstand more severe conditions,

whereas mule deer in poor health during a drought may succumb in even a mild or normal winter. It is important to develop a better understanding of weather-related effects in order to improve how we manage mule deer and their habitat.

Global climate change will potentially have a much longer-term effect on mule deer and their habitats (deVos and McKinney 2007). Warmer temperatures may result in a northward shift of the ranges of plant and animal species, reduced plant vigor and productivity, changes in plant community composition, and increased prevalence of invasive plant species. These factors could affect mule deer distribution, density and productivity in Wyoming. Managing Wyoming's mule deer herds within the capacity of habitat that is less productive and more limited in availability would require managing populations at lower levels.

Changing climatic trends can be assessed using tools such as the Palmer Hydrologic Drought Severity Index (PHDSI), which measures the long-term cumulative effect of drought. Drought has been common in Wyoming since the mid-1980's, and especially since 2000 when a much more severe and longer duration drought persisted (Fig. 2). The past 15 years in particular correspond to notable decreases in mule deer populations and fawn ratios. While the PHDSI well illustrates the long-term trend toward increasingly frequent and severe drought on a statewide scale, other indices such as the Palmer "Z-Index" or the Palmer Drought Severity Index (PDSI) are likely better suited for evaluating shorter-term response in habitat conditions on a local scale.

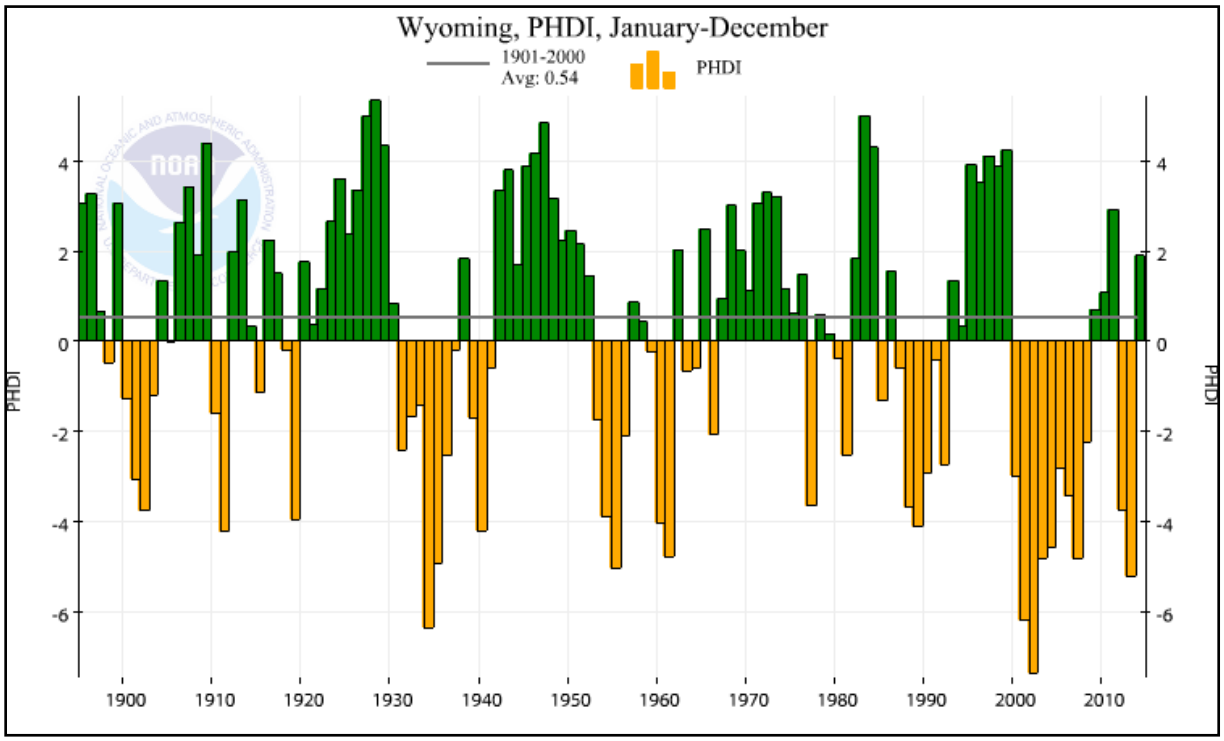


*Fig. 2. Wyoming Palmer Hydrologic Drought Severity Index, 1895-2014 (source NOAA).*

**Objective: Improve methods used to estimate winter survival of mule deer.**

***Strategy: Analyze available data on climatic trends within mule deer ranges.***

***Strategy: Study the relationships among seasonal precipitation, availability and quality of forage, and trends of mule deer populations.***

*What's been done:*

- ✓ *WGFD incorporates annual survival data into population models where applicable.*
- ✓ *WGFD will continue to analyze weather data in relation to shrub production measured on established transects and will correlate these data with mule deer survival.*
- ✓ *WGFD consults available weather data to better plan and implement prescriptive habitat treatments.*
- ✓ *WGFD conducts mortality surveys and change in ratio surveys in selected herds each spring to document the magnitude of overwinter mortality and the age and sex composition of animals that died.*

**Objective: Implement management practices to moderate the extent to which mule deer may be adversely impacted by weather.**

***Strategy: Enhance summer and transitional habitats to improve body condition of mule deer entering the winter.***

***Strategy: Maintain habitat connectivity and migration corridors to ensure mule deer have access to important seasonal habitats.***

***Strategy: Maintain mule deer herds within the habitat's carrying capacity and maintain habitats in optimal condition. Restore and improve habitats that are in suboptimal condition.***

*What's been done:*

- ✓ *WGFD has developed technical definitions of "migration corridor," "stopover site," and "migration bottleneck."*
- ✓ *WGFD has identified important migration corridors, stopover sites and migration bottlenecks, and advocates for their protection.*
- ✓ *WGFD has implemented numerous habitat treatment and improvement projects that enable mule deer to better cope with weather extremes.*

- ✓ *WGFD manages mule deer populations within established objectives to prevent habitat overuse, which in turn helps moderate the impact of unfavorable weather patterns.*
- ✓ *WGFD adaptively manages mule deer populations in response to climatic fluctuations and severe weather events.*

# Elk and Deer Interactions

Mule deer, white-tailed deer and elk potentially compete for resources where the three species' ranges overlap. Elk are predominantly grazers (eating grasses and forbs) whereas mule deer and white-tailed deer are predominantly browsers (eating shrub leaves, stems and buds). However, diets of these species change seasonally and at times, they compete directly for the same food sources. For example, newly growing forbs and grasses are important to all three species in spring and early summer. During winter, elk browse on a variety of shrubs and willows that are also eaten by mule deer. In addition, these species may compete for space at certain times of year. The degree of competition and its impact to mule deer continue to be debated among biologists. Several aspects of this question are currently being examined:

1. Dietary overlap – Although these species may consume the same types of plants or occupy the same areas at specific times of year, this does not necessarily mean they are competing. Mule deer have a higher metabolic rate than elk and their internal system is smaller and less efficient. Thus, mule deer require higher quality forage than elk during critical periods. For example, elk can subsist on cured grasses, whereas mule deer generally cannot. The two species may also avoid direct competition through ecological mechanisms such as spatial or behavioral separation, or they may simply select different plants or plant parts. In some areas of overlap (e.g., riparian areas and associated habitats), high numbers of white-tailed deer utilize the highest quality forage available before mule deer migrate from higher elevations. In spring, elk migrate to higher elevations sooner than mule deer and they can successfully forage in deeper snow. The actual degree of dietary overlap between mule deer and elk is generally thought to be limited; however, some researchers believe competition for food can have significant impacts in specific situations.

2. Effects of Development – Ranges occupied by mule deer are being physically altered and developed at unprecedented rates across the West. Energy extraction, range conversions, land management decisions, rural subdivisions, and other intensive land uses are displacing mule deer and elk from preferred habitats and altering their distribution and pattern of use. Mule deer may be more dependent on specific, traditional winter ranges and habitat conditions to survive. Elk and white-tailed deer, on the other hand, are more adaptable to change and are more capable of finding adequate habitat. While development and intensive land uses adversely affect all three species, mule deer may be impacted to the greatest degree.

3. Winter conditions – Elk are better adapted to survive in severe winter conditions. They are much larger and metabolically more efficient; they are more mobile and can forage successfully in deep snow; they can subsist on lower quality forage; and they can withstand more extreme temperatures over longer periods of time. Thus, elk populations are more likely than mule deer to remain at stable levels during sequences of normal to

severe winters, especially as the suitability of winter habitats continues to be degraded by human activities. Though white-tailed deer are similar in body size and metabolic rate, they are adapted to utilize a wider variety of habitat and forage types, enabling them to persist through severe conditions and changes in their environment. In contrast, most summer ranges are usually sufficiently large and diverse that elk and mule deer are able to disperse and find adequate conditions to meet their physiological needs.

4. Biological attributes – Several inherent characteristics of mule deer and elk populations may affect the outcome of competitive interactions between the species. Elk are longer lived and, although they produce fewer young, their survival rates are high. Elk populations are more stable and less affected by weather patterns. Elk in Wyoming also tend to occupy forested mountainous environments that are currently less impacted by development. In contrast, mule deer have shorter life spans. They produce significantly more offspring, but survival of mule deer fawns is substantially lower. Mule deer populations fluctuate to a much greater degree than elk populations. White-tailed deer populations also fluctuate to a large degree, as they have very high reproductive rates and are capable of rapid population growth and expansion when conditions are favorable. Recruitment and survival rates in particular can be extremely variable from year to year depending upon weather conditions and forage availability. Mule deer tend to occupy shrubland basins, foothills and forest edges, which are changing more rapidly as developments and subdivisions encroach. And, mule deer are much more sensitive and less adaptable to changing conditions than are elk or white-tailed deer. Although hybridization between mule deer and white-tailed deer does occur, it is very rare and is not considered a threat to mule deer (Heffelfinger 2000).

Researchers continue to study the extent and potential significance of competition between mule deer, elk and white-tailed deer. In recent decades, elk populations seem to have benefited from changing habitat conditions. Conversely, unfavorable changes in habitat have been the dominant cause of declining mule deer populations. What's less clear is whether competition with elk and white-tailed deer has been a contributing factor in mule deer declines. Mule deer have also declined in regions where there is little or no potential for competition with elk or white-tailed deer. WGFD considers the potential for competition between elk and deer in setting management objectives and in designing habitat improvement projects. However, additional research is needed to better understand whether competition has a significant impact on these species, and to identify specifically how, when, and where competition takes place. The following objectives address the potential impact of competition between mule deer, elk and white-tailed deer:

**Objective: Integrate other species' habitat needs with those of mule deer when developing and implementing habitat management plans within mule deer habitats.**

***Strategy: Coordinate species management programs when developing habitat management plans that will be implemented in important mule deer habitats.***

***Strategy: Minimize the impacts other species' management plans may have on mule deer populations and habitat.***

**Objective: Minimize potential impacts competition with other wildlife may have on mule deer populations.**

***Strategy: Identify and prioritize mule deer herd units where elk or white-tailed deer populations may be negatively impacting mule deer numbers and distribution.***

***Strategy: Where significant competition by elk or white-tailed deer is documented or believed to impact mule deer, develop harvest management strategies to reduce negative interactions with mule deer.***

*What's been done:*

- ✓ *Concerns about elk and mule deer interactions are discussed in "Mule Deer: Changing Landscapes, Changing Perspectives (MDWG 2003).*
- ✓ *WGFD attempts to manage mule deer, elk and white-tailed deer herds at or near population objectives to limit potential for competition.*
- ✓ *Elk and white-tailed deer hunting seasons have been liberalized over the past decade in an attempt to stabilize or decrease elk and white-tailed deer populations and to reduce populations that are over objective.*
- ✓ *Organizations including the Mule Deer Foundation, The Rocky Mountain Elk Foundation and The Wild Sheep Foundation have cooperatively purchased grazing AUMs (animal unit months) from willing sellers to reduce livestock stocking rates and to retire some key allotments that include important mule deer habitat.*
- ✓ *WGFD is participating with the University of Wyoming and the Muley Fanatics Foundation in the Deer Elk Ecology Research (D.E.E.R.) Project in southwest Wyoming to assess mule deer and elk interactions.*
- ✓ *WGFD assisted with research to assess the effects of mule deer and white-tailed deer competition in Converse County (Sawyer and Lindzey 2000).*

# Public Outreach and Collaboration

By any measure (social, cultural, economic, or ecological), mule deer are among the most valued of Wyoming's natural resources. To many, the species is a quintessential symbol of the open western landscape. Mule deer are also among the most popular big game species sought by resident and nonresident hunters alike. Historically, WGFD sold far more deer hunting licenses than licenses to hunt any other species. As a result, the sale of deer licenses brought more revenue to WGFD than was generated by any other species.

Mule deer management entails a myriad of biological considerations. We must also consider and integrate society's expectations into management decisions and strategies. These tenets are part and parcel with the premises of the North American Wildlife Conservation model. The most effective management strategies are founded in the species' biology, and also supported by society.

It is often difficult to gauge social preferences regarding mule deer management because at any given time, managers are more likely to hear from constituents who are dissatisfied and want some aspect of management changed, while those who are satisfied with the status quo tend to be less vigorous in expressing their support. Some of the more common issues include complaints about: hunter densities; numbers of mule deer; numbers of bucks; availability of large bucks; harvest success; hunting access; habitat conditions; and excessive off-road vehicle use. To objectively evaluate our constituents' viewpoints on these and other issues, WGFD periodically conducts a survey of licensed deer hunters' attitudes and opinions toward deer management in Wyoming (Responsive Management 2006, 2012).

WGFD's public involvement program is focused on collaboration between managers and anyone interested in mule deer management. Collaborative Learning (CL) is the opportunity to share information among a diverse group of stakeholders. CL has been the WMDI's primary medium to increase public interaction and active participation. The CL process has been successful and is ongoing in the Wyoming Range and the Platte Valley where it has resulted in stakeholder buy-in and ownership of herd management plans and other partnerships (i.e., the Platte Valley Habitat Partnership). CL is based on the following principles (Clements, 2007):

1. *Interdependent parties work together to affect the future of an issue of shared interests;*
2. *Improvement rather than solution is the goal;*
3. *The situation and progress rather than problem and conflict are the focus.*
4. *Learning and benefits are owned by all stakeholders. The creation, maintenance and progress of a collaborative learning process is owned by WGFD and all stakeholders.*
5. *Concerns and interests rather than positions are emphasized.*
6. *Interrelated rather than linear thinking is emphasized.*

7. *Through shared learning and transparency, collaborative learning creates equal access to information, allowing solutions to emerge that otherwise could not.*

CL has been a positive experience for everyone involved whether supporter or critic. Everyone has the opportunity and expectation of actively participating and being heard. People with similar or opposing points of view learn from one another when they gather around a table and feel safe expressing their opinions, thoughts, and ideas. Often they begin to understand there is a lot of complexity in wildlife management. When we hear acknowledgement of that complexity from one another, our thinking becomes interrelated and less self-focused. This is powerful! In the end, this learning provides the capacity, or "social license" to effect change – or not.

Public participation through collaborative learning ensures all stakeholders obtain an understanding of the art and science of wildlife management. That includes the science and biology of mule deer and a better appreciation of society's diverse expectations. Through CL and the WMDI, all biological and sociological data and information are brought to the table. Through the CL process we have successfully married the biological constraints or opportunities with society's expectations and desires.

**Objective: Ascertain the public's current knowledge and awareness of important issues affecting mule deer management in Wyoming. Understand the public's opinions and expectations regarding mule deer management and hunting.**

***Strategy: Conduct public opinion studies to gauge the overall [statewide] preferences of affected interests as management plans are being developed. Develop regional surveys to assess hunter knowledge and awareness, opinions, and desires relating to mule deer management at the local level.***

*What's been done:*

- ✓ *Since 2005, WGFD has compiled data from three surveys regarding deer management in Wyoming: Deer and Elk Hunters' Response to Chronic Wasting Disease (2005) and Licensed Deer Hunters' Opinions and Attitudes toward Deer Management in Wyoming (2006 and 2012). These statewide reports provide a broad overview of resident and nonresident hunters' attitudes and values regarding a variety of issues and are often consulted to guide management planning.*
- ✓ *WGFD has also conducted herd-specific attitude surveys in the Wyoming Range, Platte Valley, Bates Hole/Hat Six, Upper Powder River, Owl Creek /Meeteetse, Sweetwater, Sheep Mountain and South Wind River herd units.*

**Objective: Actively involve the public in management decisions.**

***Strategy: Utilize Collaborative Learning to involve stakeholders when addressing issues related to mule deer and their management and when developing formal management plans for specific herd units identified by WGFD.***

*What's been done:*

- ✓ *Since 2007 WGFD has utilized CL to address mule deer management in the Wyoming Range and the Platte Valley. Both efforts produced herd unit and habitat management plans, and a "Platte Valley Habitat Partnership" was also formed.*
- ✓ *Most recently, the WMDI was "rolled out" statewide with a decision to engage stakeholders through the CL process in at least one mule deer herd in each region.*
- ✓ *WGFD hosts a series of meetings and workshops throughout the year to engage the public on a range of management issues including season recommendations.*

# Research

Wildlife research can be broadly categorized as "pure research" and "applied research." Pure research is unrestricted in the sense it can address subjects ranging from highly theoretical aspects to basic characteristics of an organism or its environment. Applied research, on the other hand, seeks to answer specific questions needed to resolve a problem or improve our ability to manage a resource. Pure research has produced a great deal of information useful to the science of wildlife management and often serves as a foundation for applied research. However, most investigations conducted or supported by WGFD will address applied management questions.

Many of the issues affecting mule deer are not understood beyond a conceptual level. Natural succession, invasive plants, human developments, energy extraction, land management practices, weather and climate change, disease, predation, competition with other wildlife, and perhaps additional factors have contributed to the general decline in mule deer across the West. Through monitoring and field studies, managers are improving their understanding of how various environmental and anthropogenic stressors interact to affect mule deer and their habitat. This knowledge will help us design more effective management and mitigation strategies, and will provide essential documentation justifying the need for mitigation to offset development impacts. Managers also need to be sure management practices recommended, and those considered in the future, are effective. Applied research is being done throughout the range of mule deer to assess whether management practices are producing desired results. Practices found to be ineffective should be discontinued so available resources can be directed at strategies more likely to be successful.

We study mule deer distribution, habitat use, and movement patterns in order to focus management actions where they are most needed. Related research seeks to identify the specific environmental factors that limit the size and health of a mule deer population. This type of information enables us to better predict whether a proposed development is likely to have a significant impact at the population level, and provides a basis to select the most effective locations for habitat treatments or mitigation projects. The emergence of disease such as CWD poses additional management challenges. Research is being done to examine how deer diseases are transmitted, the extent to which they may impact populations, and how such diseases can be controlled or eliminated. Finally, investigating cost efficient means to more reliably estimate population size, mortality, and other vital factors is a priority. Improved survey techniques will ultimately increase the public's confidence (and that of our own biologists) in harvest management decisions and will improve our ability to monitor populations.

Ultimately, sound management decisions must be founded in good science. Research is an essential component of any progressive management program.

**Objective: Improve our understanding of mule deer ecology and management.**

***Strategy: Periodically update WGFD's research priorities.***

***Strategy: Maintain a cooperative working relationship with the Coop Unit, other departments at the University of Wyoming, and other research institutions. Support adequate staffing and funding for the Coop Unit.***

***Strategy: Secure an adequate budget including external funding sources to support WGFD's highest research priorities.***

***Strategy: Continue to pursue and support the creation of a WGFD position that would assist personnel with monitoring, survey and study designs, population estimation methods, and statistical analyses.***

*What's been done:*

- ✓ *WGFD is the principal agency cooperator working with the University of Wyoming Cooperative Wildlife Research Unit. We provide funding, technical and logistic assistance, and we identify and prioritize research needs.*
- ✓ *WGFD also conducts research on a limited basis.*
- ✓ *WGFD seeks involvement by NGOs, conservation groups, sportsmen's and outfitter groups to help fund research, provide logistical support, and participate in management and research programs.*

**Objective: Identify the most important factors affecting mule deer survival and recruitment, and estimate the extent they affect populations.**

***Strategy: Monitor and assess annual survival of mule deer.***

***Strategy: Assess pre and post winter nutritional condition (i.e. fat reserves) of adult females.***

***Strategy: Determine late winter fetal rates based on ultrasonography. Determine fall recruitment rates based on annual herd composition surveys.***

***Strategy: Compare survival of mule deer fawns among herd units throughout the State to quantify productivity of different herds.***

***Strategy: Evaluate shifts in distribution and habitat use resulting from competition with elk, white-tailed deer and pronghorn.***

***Strategy: Evaluate the degree to which competition with elk and white-tailed deer on summer and transition ranges affects mule deer productivity and habitat use.***

***Strategy: Evaluate the degree to which competition with elk, white-tailed deer and pronghorn on winter ranges affects mule deer habitat use and survival.***

***Strategy: Evaluate predation impacts on survival of mule deer fawns and more importantly, recruitment to adult age classes.***

***Strategy: In areas where predators may be having a significant impact on mule deer populations, assess how predation may influence mule deer survival and age/sex composition of the population.***

*What's been done:*

- ✓ *WGFD has participated in several investigations to identify factors affecting annual and seasonal movements of mule deer.*
- ✓ *WGFD is cooperating with research consultants, Federal agencies, and energy companies to assess distribution shifts and survival of mule deer throughout Wyoming.*
- ✓ *WGFD has initiated a multi-faceted research project to determine nutritional carrying capacity, adult survival, productivity, nutritional condition and movements and distribution of mule deer in the Wyoming Range. This project is a cooperative effort with the Coop Unit.*
- ✓ *In June, 2015 WGFD will launch the first study of fawn survival in the Wyoming Range Mule Deer Herd. Fawns will be captured and radio-collared to determine survival rates and identify mortality factors.*
- ✓ *WGFD has partnered with the ADMB to identify partition areas in the Wyoming Range Mule deer Herd Unit that may benefit from predator control efforts.*

**Objective: Investigate the impacts of human development.**

***Strategy: Conduct research on both a statewide and regional scale to evaluate impacts of: 1) energy development, 2) vehicle and train collisions, 3) highway construction, 4) fence construction, 5) reservoir construction, and 6) large-scale shrub control projects and rangeland conversions.***

***Strategy: Assess impacts of housing and subdivision construction, and human-caused habitat fragmentation within mule deer migration corridors and habitats.***

*What's been done:*

- ✓ *WGFD is cooperating with research consultants, Federal agencies, and energy development companies to study mule deer impacted by the Pinedale Anticline, Atlantic Rim and Baggs area oil and gas fields. These studies will document the impact intensive natural gas field developments have on survival and distribution of adult mule deer that winter in these areas.*

- ✓ *The Pinedale Anticline and Atlantic Rim oil and gas development projects were designed to help identify impacts on local mule deer populations and to determine appropriate mitigation.*
- ✓ *WGFD personnel worked with the Wyoming Department of Transportation (WYDOT) and local conservation groups to develop plans for minimizing vehicle collisions with mule deer. These plans have resulted in construction of under- and over-passes in the Pinedale, Nugget Canyon, and Baggs areas.*
- ✓ *A number of publications referenced in the Population Management Section have resulted from the research identified above.*

**Objective: Improve survey methods and other techniques used to estimate size and trends of mule deer populations.**

***Strategy: Determine the levels of adult female survival and recruitment (post-hunt fawn:doe ratios) that result in population changes in representative areas. Apply this information to improve WGFD's population simulation models.***

***Strategy: Continue examining how weather data may be applied to modify survival estimates used in model simulations of annual mule deer population size and trend.***

*What's been done:*

- ✓ *WGFD and Western Ecosystems Technology, Inc. have applied the quadrat sampling procedure to census mule deer populations on winter ranges occupied by the Sublette mule deer herd. To control costs, a systematic sample (grid) is surveyed.*
- ✓ *WGFD has tested a sightability model for estimating mule deer abundance and adapted it to Wyoming.*
- ✓ *On an ongoing basis, WGFD evaluates techniques used by other wildlife agencies to estimate mule deer population size.*
- ✓ *WGFD, in conjunction with the University of Wyoming, has evaluated the reliability of computer simulation models for estimating sizes of mule deer populations and for tracking population trends.*

**Objective: Study habitat selection by mule deer.**

***Strategy: Evaluate how adult bucks (age 2+) utilize hiding and security cover in relation to its availability during the hunting season.***

***Strategy: Evaluate whether there is significant overlap in the habitats selected by female mule deer and elk during and after the parturition period. Determine if competition for reproductive habitat impacts productivity of mule deer.***

***Strategy: Identify stopover areas mule deer use during annual spring and fall migrations and assess plant phenology and key plant selection by mule deer.***

***Strategy: Identify habitat characteristics at parturition sites in relation to fawn survival and recruitment.***

*What's been done:*

- ✓ *Key stopover points have been identified through radio-marked animal movements in the Wyoming Range, Sublette, Platte Valley and Baggs herd units.*

**Objective: Improve our knowledge of how various vegetation management techniques affect mule deer and their habitat.**

***Strategy: Evaluate vegetation and mule deer response to various applications of prescribed fire and other treatment techniques in sagebrush steppe, mountain shrub, aspen, conifer and riparian habitats.***

***Strategy: Include pre- and post-treatment monitoring in habitat treatment projects to assess mule deer response.***

**Objective: Investigate susceptibility of mule deer populations to diseases.**

***Strategy: Evaluate the prevalence, transmission, and spread of diseases such as CWD and EHD, and the potential for an effective vaccine.***

***Strategy: Investigate other methods to reduce population-wide effects of these diseases.***

*What's been done:*

- ✓ *WGFD has participated in a large mule deer CWD epidemiology study.*
- ✓ *WGFD is currently assessing the efficacy of a CWD vaccine on elk.*
- ✓ *WGFD conducts surveillance statewide to assess prevalence of CWD in mule deer. Hunter-provided samples are collected at check stations, warden stations, and WGFD offices.*

# Funding and Support

WGFD expended more than $7.7 million to fund mule deer management in 2013. Data collection and enforcement constitute the largest expenditures in each of the 37 mule deer herds. WGFD foresees three critical needs that will require significant additional funding in the future: 1) Landscape-scale habitat management; 2) Energy impact analysis and mitigation; and 3) Research and management.

Much of WGFD's current emphasis is directed at conserving and enhancing mule deer habitat. This effort involves monitoring habitat conditions throughout the state, participating in land use planning, overseeing collaborative projects to protect and improve mule deer habitats, and implementation of habitat treatment and management actions.

Habitat must be managed on a landscape basis if mule deer herds are to be sustained at levels desired by the public and in balance with available habitat. To achieve this, land use plans must address the ecological requirements of all species including mule deer. Habitat treatments must also be implemented at a cumulative scale sufficient to realize population-level responses by mule deer. These efforts will require significant new sources of funding as well as cooperative partnerships with industry, private landowners, federal agencies, and nongovernmental organizations (NGOs). Collaborative partnerships are the most effective means to secure funding from new and traditional sources. Numerous conservation organizations, federal and local governments, industry partners, agricultural entities, charitable foundations, etc. have contributed to date. Their cooperative efforts and contributions are sincerely appreciated!

Wyoming is the leading energy exporter among all states and expansive energy development continues to be a major focus. It is imperative we understand the extent to which these developments affect mule deer populations and find ways to effectively mitigate the impacts. Energy companies are the most appropriate source of funding needed to study and mitigate impacts.

WGFD continues to identify research and monitoring studies needed to better understand mule deer population dynamics and seasonal habitat use throughout Wyoming, and to improve population estimation methods. Substantial gaps in knowledge continue to exist at the herd unit level regarding seasonal movements and migration corridors, herd-specific survival rates, causes of mortality, effects of disease, and carrying capacity of the habitat. Knowledge about the nutritional carrying capacity of landscapes is becoming increasingly important. Managers are now recognizing the nutritional condition of does when they enter winter is perhaps the most important factor affecting the subsequent year's production and survival of fawns. However, this is very difficult to ascertain in the absence of expensive, herd-specific research. Budgetary constraints also impact our ability to collect data and lack of data renders population estimation more difficult in many herds. For example, WGFD simply does not have funds or staffing to radio-collar a sample of mule deer in most herds in

order to obtain annual survival estimates, monitor movements, or conduct sightability surveys similar to the work recently completed in the Platte Valley. These facets of research and management are necessary to better understand mule deer population dynamics in each herd. Such work is often cost-prohibitive, however increased funding and support for research and management will ultimately improve the capability of wildlife and land managers to conserve and manage Wyoming's mule deer.

**Objective: Fund WGFD's mule deer management program at a sufficient level.**

***Strategy: Increase funding to conduct priority research on mule deer and their habitat.***

***Strategy: Increase funding and staffing levels needed to conduct priority habitat work.***

***Strategy: Increase funding for population monitoring such as radio-marking mule deer to obtain annual survival estimates, conducting more intensive classification and abundance surveys, and better defining seasonal movements and migration corridors.***

***Strategy: Determine appropriate levels of funding and an implementation schedule to reasonably accomplish the above tasks.***

*What's been done:*

- ✓ *During the Fiscal Year 2014, maintenance and operations expenditures for WGFD's mule deer management program totaled $ 6,745,783. Over the preceding 5 years, the average annual cost was $7,641,536.*
- ✓ *The Commission has annually appropriated funding to support research by the Coop Unit. This research addresses a myriad of wildlife topics throughout the state, including priority research needed to support mule deer management.*

**Objective: Seek new sources of funding to implement landscape scale habitat treatments, better understand impacts of energy development, and identify mitigation corridors. Adequately fund priority research.**

***Strategy: Develop collaborative partnerships with NGO's, government agencies, and private companies to address the funding needs.***

***Strategy: In compliance with the Commission's Mitigation Policy (VII H, March 22, 2012), consider creating mitigation accounts to accept money from natural resource developers to mitigate their impacts to mule deer. This is normally the last option in the mitigation sequence to be considered when avoiding and minimizing***

***the impact, and repairing, restoring or rehabilitating the affected environment are not feasible.***

*What's been done:*

- ✓ *The Jonah Interagency Office and Pinedale Anticline Project Office in Pinedale were created in partnership with the Federal Government and Industry to implement mitigation programs that will address wildlife habitat impacts arising from large-scale energy development.*
- ✓ *Several WGFD personnel serve on NGO Project Advisory Committees (i.e. MFF, RMEF, WSF, etc.) that leverage funding for habitat improvement projects in Wyoming.*
- ✓ *General fund money has been appropriated by the legislature for WGFD's Veterinary Services program and the Wildlife/Livestock Disease Partnership. This has enabled WGFD to increase our surveillance of wildlife diseases and related research.*
- ✓ *WGFD has assigned personnel to serve as liaisons to numerous NGOs.*
- ✓ *The Commission is partnering with Federal land management agencies, landowners, and NGOs to leverage federal, state, and private funding sources to implement the Wyoming Landscape Conservation Initiative. This Initiative will develop a science-based program to strategically conserve, restore, and enhance wildlife habitat throughout the southwest Wyoming landscape.*

# LITERATURE CITED


Ballard, W. B., D. Lutz, T. W. Keegan, L. H. Carpenter, and J. C. deVos. Jr., 2001. Deer—predator relationships: a review of recent North American studies with emphasis on mule and black-tailed deer. Wildlife Society Bulletin 29:99–115.

Ballard, W. B., D. Lutz, T. W. Keegan, L. H. Carpenter, and J. C. deVos. Jr., 2003. Deer-predator relationships. Pages 177–218 *in* J. C. de Vos, Jr., M. R. Conover, and N. E. Heffelfinger, J. R. 2000. Hybridization in North American large mammals. Chapter 2 in S. Demarias and P. R. Krausman eds. Management and conservation of North American large mammals. Stackpole Books, Harrisburg, Pennsylvannia, USA.

Buhler, M.L., S.H. Anderson, F.G. Lindzey, and T. Cleveland. 1999. The Handbook of Wildlife Depredation Techniques: 2nd Edition. WY Game and Fish Department, Cheyenne. 680pp.

Clements. J. 2007. Collaborative learning training to Wyoming Game and Fish Department. Collaboration Program in Natural Resources Director, Ruckelshaus Institute – Haub School of Environmental and Natural Resources, Laramie, WY.

de Vos Jr., J.C., M.R. Conover, and N.E. Headrick. 2003. Mule Deer Conservation: Issues and Management Strategies. Berryman Institute Press, Utah State University, Logan.

de Vos Jr. J.C. and T. McKinney. 2007. Potential Impacts of Global Climate Change on Abundance and Distribution of Elk and Mule Deer in Western North America. Final Report to the Western Association of Fish and Wildlife Agencies.

Friend, M., J. Christian, and E.A. Ciganovich (eds). 1999. Field Manual of Wildlife Diseases. U.S. Geological Survey Information and Technology Report 1999-001. Washington, D.C. 426pp.

Hurley, M. A., J. W. Unsworth, P. Zager, M. Hebblewhite, E. O. Garton, D. M. Montgomery, J.R. Skalski, and C. L. Maycock. 2011. Demographic response of mule deer to experimental reduction of coyotes and mountain lions in southeastern Idaho. Journal of Wildlife Management 178:1–33.

Jenks, J. A., editor. 2011. Managing cougars in North America. Jack H. Berryman Institute, Utah State University, Logan, Utah, USA.

Jewell, J. E., M. M. Conner, L. L. Wolfe, M. W. Miller, AND E. S. Williams. 2005. Low frequency of PrP genotype 225SF among free-ranging mule deer (Odocoileus hemionus) with chronic wasting disease. Journal of General Virology 86: 2127-2134.

Kreeger, T.J., T. Cornish, T.E. Creekmore, W.H. Edwards, and C. Tate. 2011. Field Guide to Diseases of Wyoming Wildlife. Wyoming Game and Fish Department, Cheyenne. 218pp.

Lutz, D.W., J.R. Heffelfinger, S.A. Tessmann, R.S. Gamo, S. Siegel. 2011. Energy development guidelines for mule deer. Mule Deer Working Group, Western Association of Fish and Wildlife Agencies. 27pp. http://www.muledeerworkinggroup.com/Docs/Energy_Development_Guidelines_for_Mule_Deer_2013.pdf

McDonald, T. L., and S. C. Amstrup. 2001. Estimation of population size using open capture-recapture models. Journal of Agricultural, Biological, and Environmental Statistics 6:206-220.

Mertins, J.W., J.A. Mortenson, J.A. Bernatowicz, and P. B. Hall. 2011. Bovicola tibialis (Phthiraptera: Trichodectidae): Occurance of an Exotic Chewing Louse on Cervids in North America. Journal of Medical Entomolgy 48:1-12.

Monteith, K., T. Stephenson, V. Bleich, M. Conner, B. Pierce, and T. Bowyer. 2013. Risk-sensitive allocation in seasonal dynamics of fat and protein reserves in a long-lived mammal. Journal of Animal Ecology, 82:377-388.

Morrison, T. 2012. User guide: spreadsheet model for ungulate population data. Appendix A-09b in S.A. Tessmann and J. Bohne (eds). Handbook of Biological Techniques: third edition. WY Game & Fish Department, Cheyenne.

MDWG (Mule Deer Working Group). 2003. Mule Deer: Changing landscapes, changing perspectives. Mule Deer Working Group, Western Association of Fish and Wildlife Agencies. 30pp.

ODFW (Oregon Department of Fish and Wildlife). 2010. Exhibit 15: Letter to Antelope Ridge Wind Farm commenting on draft Elkhorn Big Game Monitoring Study Report. Oregon Department of Fish and Wildlife, Portland. 10pp. http://www.blm.gov/style/medialib/blm/nv/field_offices/las_vegas_field_office/energy/searchlight_wind/supplemental_information.Par.47775.File.dat/Exhibit%2016.pdf

Pierce, B. M., V. C. Bleich, K. L. Monteith, and R. T. Bowyer. 2012. Top-down versus bottom-up forcing: evidence from mountain lions and mule deer. Journal of Mammalogy 93:977–998.

Porter, M.A. 1999. Spatial relationships of sympatric mule deer and elk in south-central Wyoming. M.S. Thesis. University of Wyoming, Laramie. 73 pp.

Responsive Management. 2006. Licensed deer hunters' opinions on and attitude toward deer management in Wyoming. 130 Franklin Street Harrisonburg, VA 22801. 564 pp.

Responsive Management. 2012. Wyoming mule deer hunters' opinions on mule deer hunting and mule deer management. 130 Franklin Street Harrisonburg, VA 22801. 255 pp.

Sandrini, J., B. Lanka, S. Tessmann, J. Cole, S. Edberg, G. Fralick, N. Hymas, L. Jahnke, D. Lutz, B. Rudd. 2007. Hunting mule deer and white-tailed deer with species specific licenses: An analysis and recommendations. Wyoming Game & Fish Department; Deer Licensing Working Group

Sawyer, H. and F. Lindzey (2000). Ecology of sympatric mule deer and white- tailed deer in riparian communities of Southeast Wyoming. WY Cooperative Fish and Wildlife Research Unit, University of Wyoming, Laramie. 49pp.

Sawyer, H. 2007. Final Report for the Atlantic Rim Mule Deer Study. Western Ecosystems Technology, Inc., Cheyenne, WY

Sawyer, H., C. LeBeau, and T. Hart. 2012. Mitigating roadway impacts to migratory mule deer – a case study with underpasses and continuous fencing. Wildlife Society Bulletin 36:492-498.

Sawyer, H., F. Lindzey, and D. McWhirter.2005. Mule deer and pronghorn migration in western Wyoming. Wildlife Society Bulletin 33:1266-1273

Sawyer, H. and M. Kauffman. 2011. Stopover ecology of a migratory ungulate. Journal of Animal Ecology 80:1078-1087.

Sawyer, H., M. J. Kauffman, and R. M. Nielson. 2009. Influence of well pad activity on the winter habitat selection patterns of mule deer. Journal of Wildlife Management 73: 1052-1061.

Sawyer, H., R. Nielson, and D. Strickland. 2009. Sublette Mule Deer Study (Phase II): Final Report 2007. Western Ecosystems Technology, Inc. Cheyenne, Wyoming, USA.

Sawyer, H., R. Nielson, F. Lindzey, and L. McDonald. 2006. Winter habitat selection of mule deer before and during development of a natural gas field. Journal of Wildlife Management 70:396-403

Thiele, D. 2007. Chapter 2: Mule Deer (*odocoileus hemionus*). Pages 2-1 to 2-27 in S.A. Tessmann and J. Bohne (eds). Handbook of Biological Techniques: third edition. WY Game & Fish Department, Cheyenne.

Thorne, E.T., N. Kingston, W.R. Jolley, and R.C. Bergstrom (eds). 1982. Diseases of Wildlife in Wyoming. Wyoming Game and Fish Department, Cheyenne. 353pp.

Tollefson, T., L. Shipley, W. Meyers, D. Keisler, and N. Dasgupta. 2010. Influence of summer and autumn nutrition on body condition and reproduction in lactating mule deer. Journal of Wildlife Management, 74:974-986.

Tollefson, T., L. Shippley, W. Meyers, and N. SDasgupta. 2011. Forage quality's influence on mule deer fawns. J. Wildl. Mgmt, 75:919-928.

Wallmo, O.C. 1981. Mule and black-tailed deer of North America. University of Nebraska Press, Lincoln.

Webb, S.L., M.R. Dzialak, K.L. Kosciuch, and J.B. Winstead. 2013. Winter resource selection by mule deer on the Wyoming-Colorado border prior to wind energy development. Rangeland Ecology & Management. 66(4):419-427.

Webb, S.L. and M.R. Dzialak, D. Houchen, K.L. Kosciuch, and J.B. Winstead. Spatial ecology of female mule deer in an area proposed for wind energy development. Western North American Naturalist 73(3):347-356.

White, G.C. and B.C. Lubow. 2002. Fitting population models to multiple sources of observed data. J. Wildl. Mgmt. 6(2):300-309.

WGFC (Wyoming Game and Fish Commission). 2006. Policy No. VII R: Predatory animal and predacious bird management recommendations for the benefit of wildlife. Pages 180-184 in Policy Manual: Wyoming Game and Fish Commission. Cheyenne, WY. 197pp.

WGFD (Wyoming Game and Fish Dept.). 2010a. Recommendations for development of oil and gas resources within important wildlife habitats. Wyoming Game and Fish Department, Cheyenne. 236pp. https://wgfd.wyo.gov/web2011/Departments/Wildlife/pdfs/HABITAT_OILGASRECOMMENDATIONS0000333.pdf

WGFD (Wyoming Game and Fish Dept). 2010b. Wildlife protection recommendations for wind energy development in Wyoming. Wyoming Game and Fish Department, Cheyenne. 67pp. https://wgfd.wyo.gov/web2011/wildlife-1000453.aspx

WGFD (Wyoming Game and Fish Dept). *In Review*. Recommendations for Managing Mule Deer Habitat In Wyoming. Wyoming Game and Fish Department. Cheyenne, WY.

Young, D., and H. Sawyer. 2006. Wildlife Crossing Study: US Highway 287/26, Moran Junction – Dubois. Western Ecosystems Technology, Inc., Cheyenne, WY

# APPENDIX 1.

## Mule Deer Feeding Criteria and Logistics for Emergency Winter Feeding

**(ver.06182015)**

**INTRODUCTION:**

Wildlife managers struggle to develop quantifiable methods and criteria to determine when and if to feed mule deer during extreme winter weather conditions. Discussions and debate often focus on balancing extremely difficult logistics and high costs with the reality emergency feeding results in minimal or no success influencing overall survival of mule deer. This document provides criterion and logistical information and guidance to assist decision makers regarding the efficacy of emergency winter feeding mule deer.

**MULE DEER FEEDING CRITERIA:**

Any decisions whether or not to implement an intensive winter feeding program need to be based on the mule deer population's dynamics and response, or likely response, to extraordinary harsh winter conditions. The goal of an emergency winter feeding program is to limit mule deer mortality. Therefore, the primary criterion to be considered is the likelihood of higher than normal (average ~15-20%) winter mortality in the reproducing segment (does) of the population. Any prediction that doe winter mortality will exceed 30% needs to be made as early as October or November to increase the likelihood the feeding program will be at least minimally successful.

Primary Criterion:

Predicted winter-related adult female mortality will likely exceed 30%.

Secondary Criteria:

These secondary criteria will be evaluated to assess if any population under review is at risk of losing greater than 30% of the adult females (loss identified under the primary criteria). These criteria will be considered aggregately to predict mortality rates. Not all data is available for all herds.

1. At least 70% of winter forage is unavailable due to snow depth, crusting conditions, or because a catastrophic event such as wildfire has removed forage. This will be estimated through ocular estimation of winter ranges. These conditions will be considered more significant the earlier they occur in the winter.
2. Daytime temperatures are below 0 degrees Fahrenheit for a minimum of 5 consecutive days.
3. Long-term weather forecasts suggest no amelioration of conditions within the foreseeable future.

In addition to those criteria listed above, managers will also consider the following when assessing the final decision whether to begin an emergency feeding operation.

1. Feeding shortstops migrations of deer to traditional winter ranges.
2. Significant fawn mortality detected.

3. Productivity on key shrubs is below the previous 5-year average and resulting browse will result in 100% use of current annual growth.
4. Probability of mule deer disease outbreak or transmission.
5. Increased threat to human safety.
6. Cost.

The Wildlife Division Chief will confer with the affected WGFD regions and will be responsible for the final decision whether or not to initiate an emergency feeding operation.

**Frequency of Feeding:**
The Platte Valley and Wyoming Range mule deer herds, 2 of the key mule deer herd units identified in the MDI, likely exceeded 30% adult female mortality after the winters of 1978-79, 1983-84, and 1992-93. Based on the primary criteria, the Department would have considered implementing an emergency feeding program 3 times in the past 30 years

## WINTER FEEDING LOGISTICS

Any emergency feeding operation would take a large-scale coordinated effort, including the dedication of necessary and considerable funds, manpower, and organization to accomplish the task. It is recommended, based on the experience of the Colorado Parks and Wildlife (CPW) during their 2008 feeding operation, planners consider 5 key components: 1) An Incident Command Center, 2) Equipment, 3) Feed, 4) Personnel/Volunteers, and 5) Coordination with other agencies and landowners.

Command Center:
If the decision was made to feed, Wildlife Division Administration would establish an "Incident Command" style system to manage and oversee feeding operations similar to the United States Forest Service (USFS) fire-fighting operations. Emergency funding would be sought from the Commission and once approved, an incident commander would be appointed by the Wildlife Division Chief to oversee the operation. This person would meet with feed operation staff and make assignments relative to the overall operation (Attachment A). Additional staff would be assigned to the project by Wildlife Administration.

Equipment:
WGFD would need to dedicate much of its current equipment inventory to adequately initiate a mule deer-feeding operation. Equipment needs will vary depending on the size of the feeding operation and area topography. WGFD has the following equipment that would need to be available to initiate a mule deer feeding operation:

- 2 snowcats.
- 30 snowmobiles or tracked ATVs.
- Numerous 4-wheel drive trucks.
- 20 snowmobile trailers.
- 1 front-end loader.
- Cell phones.
- Portable radios.

- Truck radios.
- Command center base radio.

Snowcats would be used for large feed delivery, baiting elk away from feed sites, and moving personnel to and from feeding sites. Snowcats could also be used to pack down snow at feeding sites allowing animals to walk on top of the snow. Snowmobiles or tracked ATVs would be used to deliver feed to feeding sites. Snowmobiles or tracked ATVs work well because they can be easily loaded, unloaded and moved between feeding sites in a short amount of time.

WGFD does not have the following equipment and would need to lease, contract, or purchase these items:

- Heavy lift helicopter service for aerial hay drops.
- Helicopter service for aerial observation flights.
- Sleds to haul feed behind snowmobiles/tracked ATVs.
- Dumpster roll-off for excess garbage (feed sacks & carcasses).
- If wildlife disease is a concern it may be necessary to secure an incinerator for carcass disposal.
- Storage pods to keep feed dry.
- Snow grader to keep roads open as necessary.

Heavy lift helicopters would be used to distribute hay into remote or inaccessible areas. Colorado Parks and Wildlife (CPW) used Heliqwest International out of Broomfield, CO. Our contact for Heliqwest International is Carson Johnson, 303-469-2932 (office) or (541) 450-5773 (cell). Heliqwest International has two helicopters available for heavy lift operations, depending on the weight to be lifted. Their B2A-Star helicopter can lift 1,100 to 1,200 pounds and costs approximately $1,850 per hour. Their Bell 205 helicopter can lift 2,400 pounds and costs approximately $3,500 per hour. The average large square bale of hay weighs between 900 - 1,200 pounds. These heavy lift helicopters can drop a single load of hay in about twenty minutes when carrying the load fifteen miles to the drop site and back to the loading site. Ferry time would also be included for the helicopter to travel to and from their Broomfield base.

Aerial flights would also be needed to monitor big game movements and locate isolated big game animals. Pull-behind sleds would be necessary to haul bags of feed to and from feed sites. Every effort should be made to keep the equipment in working order. Having personnel or a contracted mechanic nearby to service equipment would be beneficial. Spare equipment in reserve and on-site would also be an important consideration.

<u>Feed:</u>
Most research indicates the wafer or pellets CPW has formulated are the most effective feed for mule deer. CPW contracted Ranch-way Feeds in Fort Collins, Colorado to produce their deer feed; formula # E4020GP. This is the only deer feed Ranch-way Feeds produces on a large scale for state agencies. The contact is Dr. Frank White at 970-482-1662. Ranch-way Feeds can produce deer feed with seven days notice and quoted the price at $364.00/ton, bagged in 50 lb. feed sacks. Delivery prices for deer feed delivered to Pinedale, would be $61.00 per ton. A loaded semi-truck can haul approximately twenty-three tons per load. Twenty-three tons of bagged feed delivered would cost a total of $9,600 ($8,400 for the feed and $1,400 for delivery).

In 2008, CPW estimated feed costs for feeding a target goal of 8,000 deer was $2,880 per day, at 2 lbs. of feed per deer/day or $86,400 per month. CPW estimated at the peak of activity they were feeding 9,600-9,800 mule deer, 450+ pronghorn, and 3,400+ elk (bait away from other feed sites) at 131 sites. At peak activity and a daily ration of 2 lbs/day, mule deer were being fed 564 bags of feed (approximately 28,200 pounds of feed or 14 tons) at a cost of approximately $5,076/day for mule deer feed, not including personnel or equipment. The amount of mule deer feed fed during the winter of 2007-08 was 838 tons, costing approximately $293,000. The amount of hay used during the same time was 880 tons ($180 per ton), costing approximately $158,400. Hay was used to bait elk away from mule deer feeding sites and to help draw mule deer and antelope into the feeding sites.

Personnel /Volunteers:

WGFD would assign personnel to work on a mule deer feeding operation, similar to our task force operations. Personnel would be needed from every region and possibly other divisions, greatly affecting normal WGFD operations. Efforts would be made to utilize local personnel to minimize costs of lodging, per diem, and travel. Based on the CPW feeding, we would need at least 50 personnel each day to conduct operations with only our staff (no volunteers). This equates to almost 100 WGFD personnel assigned to work in alternating weekly schedules to allow personnel time off. Personnel would work 7 days on and 7 days off. It is estimated WGFD personnel would spend a minimum of 52,000 hours (assuming 8 hours/day/person for 130 days) on mule deer feeding. Typical feeding operations would start mid-morning with picking up feed bags, traveling to the feeding sites, distributing the feed, traveling to the next site until all the sites have been fed, and returning to the command center. Feeding operations would only be conducted during daylight hours to avoid injuries due to low light conditions and extreme temperatures.

Four to 5 people would be assigned to work in the command center and focus on logistics, fiscal, data entry, radio dispatch, and other related tasks. The remaining 46 personnel would work as two-person teams, feeding 5 to 6 feeding sites/day.

CPW fed mule deer in the Gunnison area for about 130 days continuously at 131 feeding sites. Feeding the 131 sites utilized 60-80 volunteers and 20+ CPW personnel each day. Volunteers played a large role in the CPW feeding operation. Volunteers fed mule deer at sites that were easy to access by foot or on skis. CPW personnel typically fed from snowmobiles with a 2-person team, one operator and one person feeding off the back of the snowmobile. These 2-person teams worked in alternating schedules in four-day shifts, allowing for constant self-retraining to a new individual. This was crucial so local CPW personnel would not have to train new personnel for site location, feeding amounts, and landowner contacts.

CPW estimated minimum expenses for the Gunnison deer feeding operation at approximately $2,250,000. This estimate includes personnel time, equipment, feed, and other associated costs. Breakdown of the CPW expenses are as follows: $1.6 million for equipment, feed, and other materials and $617,000 for personnel. A further breakdown of equipment and feed expenses shows $526,000 was spent on deer feed and hay, $226,000 on damage material (elk panels), $430,000 on a heavy lift helicopter (moving hay), and $240,000 on snowcats/snowmobiles (purchased 2 snowcats and 4 snowmobiles). Pull-behind snowmobile sleds were also purchased for approximately $270 per sled.

Two cost estimates for a similar operation in Wyoming is provided (Attachment B). The first estimate is based on the entire operation is done with only WGFD personnel and the second depicts use of volunteers and WGFD staff. Costs are detailed by major category but the overall estimates are $3,790,000 and $2,670,000, respectively. These are only estimates, but are reasonable considering the Colorado mule deer feeding operation.

Coordination With Other Agencies and Landowners:

WGFD would need to work with other state and federal agencies to initiate a plan and secure required permitting for feeding on areas affected by recreational closures on winter ranges, or that may have restrictions on use of equipment, personnel, etc. Agencies include the Bureau of Land Management (BLM), United States Forest Service (USFS), Wyoming Office of State Lands and Investments (WOLSI), Wyoming Department of Transportation (WYDOT), County Road and Bridge departments, and County Sheriff's Offices. The local WGFD game wardens and biologists will coordinate with landowners to secure access on and through private property when and where appropriate and needed. WGFD will coordinate with state and county agencies to maintain access to feeding areas via county roads. In addition, it may be necessary to have WYDOT and/or country road and bridge departments to plow areas off the shoulder roadways to allow WGFD personnel to pull-off to load and unload equipment. Feeding operations are of great public interest and, therefore, extensive media coverage should be expected. WGFD would develop a media interaction plan with the Department's Communication Director and other personnel.

Conclusion:

Initiating emergency mule deer feeding would take an enormous WGFD effort. Cost estimates are over $2,000,000 for feed and equipment and normal WGFD operations would be greatly affected during the operation. An incident command approach would be used to oversee the operation and emergency funding through the Wyoming Game and Fish Commission would be necessary. WGFD personnel, and perhaps volunteers, would be used to conduct the operation depending on the scale and needs of the operation. Extensive WGFD equipment would be needed to conduct the operation and helicopter services would be needed to move feed and locate starving animals.

# Attachment A
# Wildlife Division
# Flowchart - Emergency Mule Deer Feeding

**Region determines mule deer feeding criteria have been met**

↓

**Wildlife Division Chief decision to proceed**

↓

**INCIDENT COMMANDER APPOINTED (normally Regional Wildlife Supervisor)**
- Establish location for command center (i.e. regional office, office space rental)
- Appoint regional Logistics, Operations and Communications Coordinators

## LOGISTICS COORDINATOR
(Appoint specific managers as needed)

<u>Equipment:</u>
-Snowcats
-Snowmobiles
-Tracked ATVs
-Trailers
-Trucks
-Frontend loader
-Cell phones
-Satellite phones
-Portable radios
-Command center base radio
-Etc.

<u>Maintenance & Repair:</u>
-Contract mechanic (snowmobile repairs)

<u>Establish Office:</u>
-Computers
-Printers
-Copier
-Etc.

<u>Fiscal:</u>
-Establish approx. costs
-Seek Commission funding
-Contracts
-Rental agreements
-Etc.

## OPERATIONS COORDINATOR
(Appoint specific managers as needed)

Conduct aerial deer abundance/ distribution survey

<u>Feed Distribution</u>
-Order deer feed
-Order hay to bait elk away
-Delivery system (heavy lift helicopter)

- Establish feeding Sites
-Prioritize feeding sites
-Appoint feed site managers

## COMMUNICATIONS COORDINATOR
(Appoint specific managers as needed)

-Volunteers
-Sportsmens groups
-Landowners

<u>Communications Plan:</u>
-Media coordination
-Internal updates

# ATTACHMENT B - MULE DEER WINTER FEEDING COSTS

| **Deer Feeding Operation - Department Personnel Only - Feeding 130 days** | | | | |
|---|---|---|---|---|
| | | | | |
| # Department Employees Needed Daily | Average Salary/Hour | Number of Man Hours Required (8 hrs./person) | | Cost |
| 50 | $30 | 52,000 | | $1,560,000 |
| | | | | |
| | Per Diem Rate | Per diem # Days | | |
| | $56 | 130 | | $364,000 |
| | | | | |
| Number of Rooms | Lodging Rate | Lodging # Nights | | |
| 25 | $120 | 130 | | $390,000 |
| | | | | |
| | | | **PERSONNEL TOTAL** | **$2,314,000** |

| **Deer Feeding Operation - Department Personnel and Volunteers - Feeding 130 days** | | | | |
|---|---|---|---|---|
| | | | | |
| # Department Employees Needed Daily | Average Salary/Hour | Number of Man Hours Required (8 hrs./person) | | Cost |
| 25 | $30 | 26,000 | | $780,000 |
| | | | | |
| | Per Diem Rate | Per diem # Days | | |
| | $56 | 130 | | $182,000 |
| | | | | |
| Number of Rooms | Lodging Rate | Lodging # Nights | | |
| 15 | $120 | 130 | | $234,000 |
| | | | | |
| | | | **PERSONNEL TOTAL** | **$1,196,000** |

| **Feed & Hay** | | | | |
|---|---|---|---|---|
| Product | Cost/ton | Tons Needed | | Cost |
| Mule Deer Pellets | $364 | 840 | | $305,760 |
| Delivery | $61 | 840 | | $51,240 |
| Hay | $180 | 880 | | $158,400 |
| | | | **Feed and Hay Total** | **$515,400** |

| **Equipment** | | | | |
|---|---|---|---|---|
| | Hourly or Per Mile Rate | Hours or Miles/machine | | Cost |
| Snowcats X 2 | $49 | 780 | | $76,440 |
| Snowmachines X 30 | $6 | 780 | | $131,976 |
| Helicopter Service X 1 | $820 | 40 | | $32,800 |
| Heavy Helicopter X 1 (dropping once/week at 4 sites, 3 loads or 6 bales/hr.) | $3,000 | 135 | | $405,000 |
| 3/4 Ton Pickup Trucks (50 trucks averaging 400 miles to site for 19 weeks = 380,000 miles. 25 trucks averaging 100 miles/day feeding X 130 days = 325,000 miles) | $0.35 | 705,000 | | $246,750 |
| Snowmobile pull behind sleds ($300/sled X 20 sleds) | | | | $6,000 |
| Front End Loader | $45 | 390 | | $17,550 |
| Vehicle Accessories (tire chains, tow ropes, shovels, etc.) | | | | $3,000 |
| Dumpster rolloff ($300 per unload, 20 cubic yard) | | | | $1,500 |
| | | | **Equipment Total** | **$921,016** |

| **Miscellaneous** | | | | |
|---|---|---|---|---|
| Contractual Services (welding, mechanical, etc.) | | | | $20,000 |
| Landfill (carcass removal) | | | | $1,000 |
| Office rental ($4000/month X 4 months) | | | | $16,000 |
| Office supply (paper, copies, maps, etc.) | | | | $2,500 |
| Storage rental ((2 - 8'x8'x20' pods @ 150/month for 4 months) | | | | $1,200 |
| | | | **Misc. Total** | **$40,700** |
| | | | | |
| | | **TOTAL COST - Department Personnel Only** | | **$3,791,116** |
| | | **TOTAL COST - Department and Volunteers** | | **$2,673,116** |