Mule Deer
(Odocoileus hemionus)

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General information

The mule deer (*Odocoileus hemionus*) is a member of the family Cervidae, which is characterized by hoofed mammals that shed their antlers annually. The mule deer is one of only a handful of large herbivores in North America that survived the great extinctions of about 7,000 to 12,000 years ago.

The name mule deer is in reference to the animal's relatively large ears and robust body form, at least in comparison to the more slender structure of its close relative, the white-tailed deer. Mature bucks weigh 150 to 200 pounds on average, though some may exceed 300 pounds. Does are noticeably smaller than bucks, ranging from 100 to 150 pounds at maturity. The coat color of the mule deer is seasonal, turning from a reddish-brown in summer to a blue-gray in winter. Although shading is variable, mule deer generally have light colored faces, throats, bellies, inner leg surfaces, and rump patches. The tail is short, narrow, and white with a black tip and, unlike the white-tailed deer, is not raised when the animal is alarmed. Mule deer have good binocular vision, acute senses of hearing and smell, and sensitivity to movement. Vocalization is rare in adults, but fawns may bleat on occasion.

Age distribution is generally classified as follows: fawn, birth to 1 year of age; yearling, from 1 to 2 years of age; adult, over 2 years of age, further subdivided into prime (3 to 6 years of age) and old (>7 years of age). While patterns or characteristics of teeth provide the most accurate indication of age among adult mule deer, other factors such as body size, hair color, and, in males, antler growth may provide a general indication of maturity. The size and number of antler points is highly variable, and depends on a combination of internal and external factors, primarily genetics, age, and nutritional status. Antlers generally increase in size and may increase in number of points as a mule deer matures. Bucks tend to produce their largest antlers at approximately 5 to 6 years of age.

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Mule deer *(Odocoileus hemionus)*

This leaflet is intended to serve as a basic introduction to mule deer habitat requirements and assist private landowners and managers in developing management plans for mule deer. The success of any individual species management plan depends on targeting the particular requirements of the species in question, evaluating the designated habitat area to ensure that such requirements are met, and determining appropriate management techniques to further improve habitat quality.

Range

Extremely adaptable, mule deer inhabit every principal vegetative ecosystem in western North America except tundra, sub-tropic, and extreme desert regions. Open grasslands, agricultural land, shrublands, woodlands, mountain forests, semi-deserts, and high mountain ecosystems all support mule deer populations. Although mule deer inhabit a wide variety of ecosystems, the species is largely restricted to the region of North America west of the 100th meridian from 23 degrees to 60 degrees north. Due to distributional and reproductive overlap, there is a lack of consensus on the exact number of subspecies, but as many as 11 have been recognized. Table 1 lists mule deer subspecies and their ranges.

Mule deer populations have experienced a steady decline over most of the species' traditional range. For instance, the approximately 600,000 mule deer in Colorado represent only about half of the peak population estimated for the state in the 1940s. Likewise, the current mule deer population in California is estimated to be less than half of the two million or so that roamed the state as recently as the 1950s. Other regions reflect parallel declines: in both Utah and New Mexico, populations have been halved in less than thirty years. While populations are stable in some regions and even increasing slightly in others, overall mule deer trends show a continual decline throughout its range.

Mule deer habitat is subject to an extensive and expanding array of external pressures, including urban and rural development, agriculture, logging, grazing, and oil and gas development. These pressures contribute to the loss of approximately 2,500 acres of suitable mule deer habitat every day. Another factor in mule deer declines is the introduction of non-native vegetation, which adversely affects native ecosystems and is usually of less nutritional value or often wholly unpalatable to mule deer and other wildlife. Climatic changes, such as drought and severe winters, play a key role in declines in mule deer populations. In addition, poorly conceived woodland management programs may impact mule deer populations. For instance, fire suppression may have led to a decline in both food availability and quality by limiting mule deer access through litter accumulation and by impeding the growth of new forage.

Reproduction

Mule deer breeding season (commonly referred to as the rut) varies considerably from region to region. The rut typically begins in the fall and extends through mid-winter, peaking in December or January. Antler growth begins as soon as the old antlers have been shed (late January through early March), with full development completed by the end of August. With their antlers fully developed in the fall, males of reproductive age begin to form competitive dominance hierarchies for access to reproductive females. Once accepted by a female in estrus, a dominant buck will tend the doe until mating is completed or the buck is displaced by another male. Mule deer bucks are serially polygynous, that is, they will mate with any female willing to accept them.

Male dominance is largely a function of both body size and correlated antler size, with the largest males performing the majority of mating. Mule deer does remain in estrus for about 24 hours and continue to cycle approximately every 28 days if they do not mate successfully. Mule deer, both male and female, generally do not reach sexual maturity until approximately 1.5 years of age. Does rarely breed during their first year and average less than one fawn per doe during their second fawning season, becoming more productive at 3 years or older. Does will frequently produce twins when habitat conditions are favorable. The majority of reproductive-age females breed in any given year, although reproductive success is highly dependent on habitat conditions.

Table 1 Mule deer subspecies and ranges

Common name (scientific name)	Range
Rocky Mountain mule deer (Odocoileus hemionus hemionus)	Southwestern Saskatchewan west through southern Alberta and British Columbia, extending south throughout WA, OR, ND, SD, KS, NE, MT, WY, CO, UT, and ID, and into northeast CA, sections of NV, AZ, NM, TX, OK, and northern Mexico
Desert mule deer (O. h. crooki)	Semi-arid areas of CA, NV, AZ, NM, TX, and northern Mexico
California mule deer (O. h. californicus)	Ranging throughout CA, but particularly common in High Sierra
Southern mule deer (O. h. fuliginatus)	Ranging from northern Baja CA into southwestern CA
Black-tailed deer (Columbian) (O. h. colubianus)	Wet-forest coastal areas of WA, OR, and southern British Columbia, and relatively common throughout CA
Black-tailed deer (Sitka) (O. h. sitkensis)	Southeast AK, Yukon, and the north coast of British Columbia

Gestation lasts on average around 200 days (~ 7 months), but may vary by as much as plus or minus 30 days. When they are ready, pregnant does leave their herds to find isolated thickets in which to give birth. Fawns are born in May through July, although timing may vary somewhat depending on both environmental conditions and geographic location. Fawning occurs primarily in areas that offer protective cover, such as moderately dense shrublands and forest, thick herbaceous stands, or high-elevation riparian and mountain shrub habitats that offer both access to water and abundant nutritious spring forage. Fawn survival rates depend on environmental conditions, exposure to disease, and predation. Research in Colorado concluded that fawn mortality rates in the summer following birth may be as high as 50 percent, and that fawn survival rate impacts long-term population trends more so than adult survival rate.

On average, fawns weigh 6 to 8 pounds at birth and are reddish-brown with white spots that give a cryptic mottled effect. Fawns are able to stand and move about on their own within 12 hours of birth, but generally remain hidden and motionless for protection. Fawns have little or no scent and does habitually stay away from their young except to nurse so as to minimize the risk of attracting predators. Fawns begin feeding on vegetation at 2 to 3 weeks and are fully weaned at 2 to 3 months of age. Fawns grow rapidly over the summer as they take advantage of the abundance of highly nutritious forage and often reach weights of 70 to 80 pounds by the fall. A typical family group may consist of one or more females with their young, accompanied on occasion by a yearling buck. Fawns usually remain within the family group for a year, after which female yearlings may be allowed to remain while bucks of the same age are either forced to leave or depart on their own. Life expectancy for mule deer in the wild is approximately 7 to 10 years, although captive individuals are known to live much longer.

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Fawns are born in May through July.

Research in Texas revealed fawn survival rates of 35 to 45 fawns per 100 does. Biologists estimate that early winter fawn crops of at least 30 to 35 are needed to maintain population stability, while fawn crops exceeding 50 result in population increases. Populations decline when fawn crops fall below 25.

Habitat requirements

General

Basic mule deer habitat requirements include an abundance of herbaceous forage, vegetation and landforms that provide hiding and thermal cover, and access to sources of water. Mule deer generally summer at higher elevations and migrate to lower woodlands or shrublands in winter to find food, avoid predators, and seek cover from harsh weather. Therefore, preservation of summer, winter, and transitional habitat is essential to sustaining mule deer populations.

Food

As small ruminants with limited ability to digest fibrous roughage, mule deer require soft, high-protein, easily digestible forage in order to extract sufficient energy for growth, maintenance, and reproduction. Mule deer eat a great diversity of living, wilted, dry, or decaying vegetation, including leaves, needles, succulent stems, fruits, and nuts, shrubs, forbs (non-woody herbaceous undergrowth), domestic crops, and grasses.

The feeding habits of mule deer are highly seasonal. In late spring to early fall, deer quickly gain weight and build up fat reserves by foraging heavily on the mast, leaves, and stems of trees and shrubs, as well as forbs and grasses. Succulents provide a valuable source of water for individuals living in more arid regions. In late fall, winter, and early spring, deer consume the leaves and stems of shrubs and trees. Studies in the Alberta foothills have shown that during the fall, winter, and early spring, mule deer consume naturally curing plants (silage), which are frost-killed forbs that dry, fall to the ground, and decompose. During this time, deer also depend on the mobilization of energy from body fat stored over the summer. Data collected on mule deer feeding choice in Colorado reflected seasonal feeding adjustments (table 2).

Mule deer alter feeding behavior in seasonal areas according to the form of vegetation available. Like many browsers and grazers, mule deer experience a varia-

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Mule deer reach sexual maturity at 1 to 2 years of age.

tion of metabolic requirements depending on the season; using less energy in winter enables deer to survive on the relatively poor-quality forage available, while abundant high-quality forage in spring and summer allow for increased energy expenditures, growth, and fat storage. The amassing of excess fat is essential for mule deer survival in winter, as individuals may lose up to 20 percent of total body weight during an ordinary winter and more during particularly long or severe winters. Fat is also particularly important to sustain the rutting activities of mature bucks.

Human incursions also impact mule deer foraging habits. In developed areas, domestic crops may form a large percentage of mule deer diet, reportedly as high as 51 percent in some instances. Corn and soybeans constitute the bulk of mule deer diet in such areas, but oats, wheat, rye, barley, and sorghum may also be selected, as well as fruit crops such as apples, grapes, and citrus.

Hiding cover

One of the most important habitat components for mule deer is hiding cover, as they are very sensitive to predation. Suitable mule deer habitat must contain vegetational cover or terrain that provides opportunities to escape from predators. Mule deer will search out and concentrate in areas that are void of predators. They will readily settle in human habitations, which are avoided by predators. In areas that are not void of predators, mule deer will choose to live in proximity to obstacles, usually steep slopes or broken terrain, such as mountains, sand dunes, or steep gorges. Mountain lions, wolves, coyotes, black bears, grizzly bears, lynx, bobcats, and golden eagles are the major natural predators of mule deer. While cryptic coloration and immobility when alarmed frequently allow the deer to escape initial detection, fleeing to cover is the primary form of predator evasion. To escape from predators, mule deer bound off in long, high bounds, called stotting. They can easily stott straight uphill, a feat most predators cannot duplicate. Mule deer place obstacles (tall bushes, windfalls, gorges, steep slopes, uneven terrain) in the way of pursuing predators. Mule deer are much more adept at maneuvering among these obstacles than their predators, allowing them to escape.

Thermal cover

Mule deer herds require the presence of accessible stands of brush and tree thickets to provide protection from the elements. Cover vegetation is vital for seasonal thermal regulation, helping to moderate heat in the summer and chill in the winter. Thermal cover can reduce wind speed and wind chill and provide shelter from snowfall. Additionally, vegetative cover can reduce ground snow accumulation and provide a constant source of forage, thereby improving both mobility and food availability during the winter.

Estimates for the extent of cover required vary, but it is reasonable to approximate that 40 to 60 percent of a deer's home range will provide cover, roughly half of which is composed of hiding cover and half thermal cover (although there is of course considerable overlap between the two). Researchers studying mule

Table 2 Seasonal feeding adjustments

Vegetation	Spring	Summer	Fall	Winter
Shrubs and trees	49%	49%	60%	74%
Forbs	25%	46%	30%	15%
Grasses	26%	3%	9%	11%

Bruce Hanson, NRCS

In some areas, mule deer require the presence of brush and tree thickets to provide thermal cover.

deer populations in the Great Basin region estimated that optimal habitats consisted of 55 percent forage, 20 percent hiding cover, 10 percent thermal cover, and 15 percent fawn rearing cover. Thermal cover requirements vary significantly between northern and southern regions of the species range, however, complicating attempts at generalizing proportional cover requirements. Regardless, it has been clearly demonstrated that both thermal and hiding cover are most effective when adequately distributed throughout the home range.

Water

Mule deer acquire water from numerous sources, notably springs, lakes, wetland ponds, rivers, and streams. Metabolic water may also be produced from browsed succulent vegetation, while snow pack and melt may be consumed in winter. Mule deer require approximately 0.5 gallons of water per day per 100 pounds of body weight; an average-sized animal would need to drink approximately 1.5 gallons of water per day. Field studies have shown that mule deer home range patterns are closely associated with water availability; research in Texas and New Mexico has shown that desert mule deer numbers increase markedly in habitats where a permanent source of water is introduced. This pattern is particularly noticeable in more arid segments of the mule deer range. Researchers at Craters of the Moon National Monument in New Mexico, for instance, determined that an unusual but regular summer migration of the resident herd was linked directly to the correlation between water requirements and availability. The tendency of mule deer to congregate around stable water sources often results in excessive grazing of forage plants in the immediate area of the watercourse, a problem most apparent in semi-arid regions.

Summer range

Mule deer inhabit a variety of environments in summer months. In the mountainous areas of the northwest, deer generally migrate to higher elevations following the retreat of the snow line, primarily to take advantage of new plant growth. Bucks are usually more active and often move to higher elevations than does, particularly those with fawns that must seek protective cover. In the southwest, most mule deer herds are non-migratory, though they may move in response to changes in vegetation and moisture conditions. Deer tend to roam widely during the summer, but may also concentrate around water sources where green vegetation is most abundant. Regardless of location, mule deer generally exhibit crepuscular behavior, remaining largely inactive during the day, although individuals may be active at any time during the day or night. During the summer, mule deer may be found in a variety of ecosystems, including alpine, montane, semi-desert, riparian, and foothill zones.

Winter range

Mule deer in mountainous regions migrate to lower elevations to escape snow and low temperatures. Winter conditions reduce mobility and food availability; as such, mortality rates are on average considerably higher in winter than in summer. While snow depths of 18 to 24 inches are tolerable, lower levels are sought in order to conserve energy. A 100-pound deer expends seven to eight times as much energy moving through 20 inches of snow than moving on bare ground.

On occasion, mule deer will exhibit yarding behavior, congregating in less affected areas in order to conserve energy, although there is also evidence that assemblage behavior is an evolutionary response to increased predatory pressures experienced during winter as opposed to shelter requirements. Oftentimes, however, these gathering areas include nearby developed areas such as farms and residential areas, thereby, increasing the potential for conflict with humans.

Deep snows tend to reduce usable range to a fraction of the total. In eastern Washington, for example, studies showed that deer find approximately 1 acre of usable winter range for each 15 to 20 acres of summer range. Densities may also increase as heavy snow cover concentrates individuals into areas where food is most accessible, a circumstance that may also lead to local overgrazing on the few food items available during this time.

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Mule deer can tolerate snow depths of 18 to 24 inches.

Mule deer in northern regions may also tend to concentrate on southern facing slopes in order to gain as much exposure to sunlight as possible. Estimates of resting energy requirements alone may exceed 2,000 kcal per 24 hours at an average temperature of -4°F for an adult deer, an energy drain that may be alleviated somewhat by maximizing exposure to sunshine. While lowland areas in general are sought as wintering grounds, riparian ecosystems that provide a measure of thermal and protective cover, as well as a relatively consistent and accessible food supply are particularly favorable winter habitats.

In essence, the most important factors in the selection of a wintering area are the presence of a sufficient overhead canopy to trap heat and an abundance of understory to provide both wind shelter and food. Lowland areas such as riparian ecosystems are preferred as they provide the essentials needed for mule deer to survive the winter.

Transitional range

Mule deer in northern latitudes generally summer at higher elevations and move to lower elevations at the onset of winter, and back again in spring. Such semi-annual migrations require the presence of adequate transitional habitats, as deer may travel as much as 80 miles between summer and winter ranges. Transitional ranges may be composed of a variety of habitat types depending on geographical location, but usually have several factors in common — abundant palatable vegetation, water, a measure of protective cover, and suitable fawning habitat. Generally mule deer seek out mixed woodland/open meadow habitat that provides high quality herbaceous forage, enabling them to begin the process of rebuilding body fat stores as soon as possible. Transitional areas are of particular importance to gestating does that need to locate suitable fawning habitat – moderately dense shrublands and forest, interspersed with dense stands of herbaceous material, and access to reliable sources of water. Moderate-elevation riparian areas and low mountain shrublands are ideal fawning grounds.

Mule deer inhabiting areas that lack range variation are generally non-migratory, although there is some evidence that movements in drier areas correlate with rainfall patterns.

Mineral licks

Natural mineral licks — dry earth exposures, muck licks, streambanks, and rock face licks — are often utilized by mule deer to obtain essential minerals lacking in their normal diet. In addition to sodium, deer may be seeking potassium, iron, phosphorus, magnesium, manganese, and copper. Calcium and other minerals are required for lactation and are thus of great importance for expectant does, while calcium and phosphorus are required by bucks for new antler growth. It is also believed that licks help to replace electrolytes lost by deer when scouring for fresh green growth in spring. As a result, mineral licks tend to be most commonly visited by mule deer in early spring and throughout the summer.

Interspersion of habitat components

The arrangement of habitat types found within a given area is termed interspersion. For many wildlife species, the greater the degree of habitat interspersion, the higher the habitat quality. In the case of mule deer, ideal habitat interspersion would consist of an assortment of vegetation types of varying maturity, including forest, dense brush or shrubland, open grassland, meadow and associated herbaceous areas, and a source of minerals and accessible water. As a general rule of thumb, a 60:40 ratio of forage to cover is considered optimal mule deer habitat. These elements provide mule deer with the basic requirements on which they depend for survival.

As mule deer are large social animals that make use of substantial land area, the provision of all necessary habitat components for optimal interspersion is likely to be beyond the means of individual landholders. Therefore, cooperation among neighboring property owners is essential for maintaining and improving habitat for mule deer. Providing adequate cover and water is a relatively simple action that individual landowners can undertake to contribute to the maintenance of mule deer habitat.

Minimum habitat area

Mule deer home range size varies depending on the region, habitat quality, season, and distribution of vital resources. Mean home range size for adult does

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Mule deer are migrational at nothern latitudes.

has been estimated to be 0.3 to 1.2 square miles while that of bucks approximately 1.2 to 4 square miles, but may be as large as 30 square miles. In addition, adult does may defend small areas – approximately 0.2 to 2 square miles – in late spring and early summer when caring for newborn fawns. Bucks are generally solitary, but may on occasion form small bachelor herds that collectively maintain a small territory until the beginning of the rut, at which time individuals disperse and remain solitary. Bucks also usually roam greater distances than does. Generally, mule deer with established home ranges use the same summer and winter ranges annually, although mule deer herds may migrate a considerable distance between seasonal ranges.

Densities of mule deer vary considerably, depending on local environmental conditions and availability of required resources. There is a fairly clear average density gradient from north to south: northern areas tend to be more densely populated than more arid southern regions, primarily due to increased food and water supplies. Despite these generalities; however, note that local densities vary considerably within the overall range of mule deer.

Disease

Mule deer are susceptible to a variety of viral, fungal, bacterial, and parasitic infections. Under natural conditions disease factors are not believed to cause significant problems for deer and are thought to be responsible for only a small proportion of mortality. However, the actual impact of disease is poorly understood, as causes of death are not always obvious. The overall influence of disease on mule deer populations must therefore be considered indeterminate. Furthermore, external factors also play a role: disease agents and parasites that normally occur at low levels may reach abnormally high levels in malnourished or otherwise unhealthy herds. Brucellosis, leptospirosis, vibriosis, and anaplasmosis, abortive diseases that often suppress reproductive success, have all been found in mule deer, while gastrointestinal nematodes that occur naturally may cause circulatory impairments and death.

As such cases are usually indicative of unusually high density and nutritional stress, the presence of disease could be symptomatic of more elemental problems with deer habitats or populations. Such factors as habitat loss or degradation, livestock encroachment, and an excess of deer relative to range capacity, for example, may result in the establishment and spread of diseases that would not be problematic under normal conditions. Exposure to agricultural toxins may have an immunosuppressant effect as well, further weakening disease resistance. More seriously, introduced viruses that cause the conditions known as bluetongue and epizootic hemorrhagic disease (EHD) – in which biting midges act as vectors – are known to cause local epidemics. In Colorado, for instance, epidemics of hemorrhagic disease have been intimated as the primary cause of upwards of 50 percent mortality in some mule deer herds. Both viruses are believed to have been introduced into North America through infected cattle and both cattle and white-tailed deer are known to serve as reservoirs of the EHD virus. Ticks, lice, and nasal bots (the larvae of bot flies) are common parasites that under normal conditions are largely harmless, albeit bothersome, but which may become detrimental to health in stressed individuals or herds.

Chronic wasting disease (CWD), a disease similar to mad cow disease of cattle, has been identified in some mule deer populations in western North America. Classed as a member of the transmissible spongiform encephalopathies (TSEs), CWD is an untreatable, fatal neurological disease. Although uncertain, transmission most likely occurs through contact with saliva, feces, or urine. Diagnosis is complicated by the fact that infected animals may incubate the disease for up to 3 years prior to displaying clinical symptoms.

First noted among captive mule deer in Fort Collins, Colorado, in 1967, CWD has since been identified in both free-ranging and game farm animals in parts of Colorado, Wyoming, South Dakota, New Mexico, Montana, Nebraska, Oklahoma, Kansas, Wisconsin, Alberta, and Saskatchewan. In areas of Colorado and

Utah Division of Wildlife Resources

This elk has been infected with chronic wasting disease, which can also affect mule deer.

Wyoming, the disease occurs in less than 5 percent of wild deer but may be higher in more concentrated populations; a survey of one site in Nebraska determined that 37 percent of deer were infected. Infection rates among captive deer in some areas may exceed 50 percent. Due to the extended incubation period of the CWD infectious agent, mule deer herds must be monitored for at least three years to allow detection of the presence of the infectious agent. Infected animals exhibit loss of normal bodily function and abnormal behaviors such as an exaggerated wide stance posture, the lowering of the head and ears and shakiness, and become emaciated due to generally poor overall body condition. There is no evidence that the disease poses a risk to humans or domestic animals —an ongoing 16-year monitoring program in Colorado has not detected the disease in cattle or other livestock. However, health officials warn hunters not to consume meat from animals suspected of infection and to take precautions such as wearing latex gloves and minimizing the handling of brain and spinal tissues when field dressing carcasses. State fish and wildlife officials should be contacted if a sick animal is encountered or suspected.

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One-way hybridization occurs when a white-tailed buck (shown here) mates with a mule deer doe.

Limiting factors

Limiting factors for mule deer populations include the availability and quality of the habitat requirements described above. Hiding cover is particularly important because if there are predators but no hiding cover in an otherwise perfect habitat area, mule deer will avoid the area.

A major limiting factor to mule deer populations is one-way hybridization with white-tailed deer. Hybrids between mule deer does and white-tailed deer bucks do not exhibit the antipredator behavior of either species, making them very susceptible to predation. Male hybrids are usually sterile. One-way hybridization occurs when white-tailed bucks mate with mule deer does in estrus. (Mule deer bucks show little interest in white-tailed does.) This occurs more often when the larger mule deer bucks have been removed by hunting and are not present to defend mule deer does from white-tailed bucks. Mule deer bucks are hunted more frequently than white-tailed bucks because white-tailed deer are primarily nocturnal. In areas where mule deer have access to steep slopes or broken terrain, mule deer does are able to evade white-tailed bucks by stotting straight uphill. White-tailed bucks cannot pursue mule deer does in this type of terrain.

Table 3 is an example inventory chart for recording limiting factors. For planning purposes, fill in table 3 to determine the potential of a given area to support mule deer populations. Rate the habitat components and population constraints for the designated planning area based on the above descriptions. Habitat components that are absent from the area, or are available in low quantity or quality, are probably limiting mule deer populations. High prevalence of limiting factors may likewise indicate poor mule deer habitat. Land uses on adjacent properties should be taken into consideration to provide accuracy in rating the quality of a site as mule deer habitat.

Management treatments should address the habitat components that are determined to be limiting mule deer habitat potential. For planning purposes, select among the possible action items listed in table 4 to raise the quality or availability of each habitat component determined to be limiting. Programs listed in Table 4 may helpful in implementing these actions.

Mule deer habitat management

Mule deer are extremely adaptive animals that often respond favorably to habitat management and other land use practices that improve the habitat structure of a given area. Landowners interested in managing their property to benefit mule deer should consider ecological factors such as vegetation composition, patch arrangement, and water availability, as well as

practical factors such as the potential for property or crop damage, safety, and human-deer interactions.

A variety of management actions can be taken to improve mule deer habitat. More than one practice may be beneficial in an area depending on land use, the area's size, composition of vegetation, and geographic region. Management goals may also dictate which management practices are most appropriate. Consultation with, and assistance from, Federal, State, or local fish and wildlife, land management, and conservation agencies and organizations may prove useful in identifying and prioritizing appropriate measures for fulfilling management objectives.

Much of mule deer habitat has been developed, used for pasture by livestock, or converted to domestic crops, thereby creating a discontinuity of potential habitat. This fragmentation effect can be mitigated through increased landowner awareness of mule deer habitat requirements and by consequential improvement of land management to maximize habitat

Table 3 Inventory of limiting factors

Habitat component	Availability/quality			
	High	Medium	Low	Absent
Food				
Hiding cover				
Thermal cover				
Water				
Summer range (if applicable)				
Winter range (if applicable)				
Mineral licks				
Interspersion of habitat components				
Minimum habitat area				
Limiting factors	Quantity/degree of interference			
	Absent	Low	Medium	High
White-tailed deer populations				

Table 4 Management options for increasing habitat quality and availability. Technical and financial assistance programs listed in table 5 can be used to assist in these management actions.

Habitat component	Management options
Food	Maintain proportion of open field and woodland areas by conducting burning or rotational/deferred grazing where appropriate
	Preserve and plant appropriate food plants for mule deer, depending on seasonal range use and geographic region
	Minimize unnecessary development and land use
Winter range	Preserve and maintain wooded lowlands. Conduct selective tree harvesting, rotational even-aged harvest, and undergrowth prescribed burn programs to maintain varying age regime of forested areas
	Minimize human disturbance to wooded lowlands and adjoining open pasture
Transitional range	Conduct prescribed burns in forest edge environments to stimulate the growth of new vegetation
Interspersion and minimum habitat size	Combine the above prescriptions to increase interspersion of habitat components and amount of suitable mule deer habitat

NRCS

Ideal habitat interspersion for mule deer consists of a variety of vegetation types and a source of water and minerals

quality and accessibility. Unfortunately, as the needs of mule deer are usually not the primary land management goal of most private landowners in western North America, habitat improvement programs typically involve coordination of diverse interests. As such, landowners must be fully aware of the complexities of habitat enhancement programs before proceeding with management actions. One approach may lie in the design of a detailed sequential checklist outlining objectives and appropriate measures for achieving stated goals.

Prior to the implementation of field management programs, property owners need to determine the characteristics of the site in question. For one, landowners need to assess the existing conditions of the site:

- Does it provide summer, winter, or transitional range?
- What are the dominant plant communities?
- What are the grazing practices being used?
- Where are sources of water?
- What are potential areas of conflict?

Landowners can formulate an action sheet to guide habitat enhancement actions. A checklist may include a list of objectives, activity prioritization, an implementation schedule, a map of the site, a survey of existing conditions, and an assessment of the optimal habitat requirements of mule deer applicable to the site, including forage/cover ratio, water sources, and possible areas of exclusion.

Open land management

Prescribed burning

Prescribed burns aid in the recycling of nutrients and minerals and help to maintain the ecological integrity of grasslands and open woodlands. Fire can be used to stimulate new browse, create openings in areas of dense brush, and reduce ground level debris that may impede deer movement. Furthermore, periodic localized burns help to create the environmental mosaic of vegetation type and age that mule deer favor. Small burns tend to be more beneficial than large ones, as deer favor edge environments, or open areas close to cover. Landowners should be aware that burning may facilitate the advance of noxious weed species. For example, invasive cheatgrass has caused problems in areas of Colorado, Wyoming, Utah, and Idaho after burning.

Prescribed burning should be conducted in cooperation with State fish and wildlife agencies and with assistance from licensed burners. These agencies and individuals can assist in the development of a burn plan, provide necessary equipment and supervision, and aid in obtaining required permits. Prescribed burns should be conducted on a 4- to 5-year rotational basis in late winter or early spring depending on the region. Where practical, dividing the burn area into discrete strips or plots provides benefits to wildlife by leaving undisturbed patches of desirable vegetation adjacent to burned areas.

Rotational grazing

Managed grazing can be an effective tool in maintaining productive mule deer habitat. Grazed areas are most beneficial when overgrazing by livestock is avoided while allowing for a diversity of herbaceous

Jeff Vanuga, NRCS

Prescribed burns promote growth of grass and forb species while replenishing soil nutrients.

undergrowth to proliferate. Furthermore, implementing a rotational system of pasture use by livestock will result in the consistent availability of open areas for mule deer to forage while at the same time preventing overgrazing. The specifications of such a rotational program is dependent on the size of the livestock herd, the type of livestock, the vegetation composition of the site, and the topography of the pastureland. Implementing rotational land use patterns also assists in maintaining appropriate shrub/bush cover to forage ratios. Livestock type is important as browsers such as sheep and goats are more directly in competition with mule deer for forage than are pure grazers such as cattle.

Examining the percent of annual plant growth consumed by animals can be used to determine range quality. As a general rule of thumb, forage is considered too heavily grazed when >50 percent of the available annual growth of key forage species is consumed. At that point, either livestock grazing should be reduced by seasonal management – by rotational land use, for instance – or through the reduction of deer numbers by increasing local recreational hunting.

Patch burning

Patch burning, also known as rotational grazing without fences or fire-grazing interaction, is a management practice that combines rotational grazing with prescribed burning. Large-scale uniform burns and poorly managed grazing systems can be detrimental to livestock and wildlife. Patch burning provides an alternative to traditional fire and grazing programs and a practical way to restore mule deer habitat. Patch burning allows grazing and fire to interact to cause a shifting vegetation pattern across the landscape.

Jeff Vanuga, NRCS

Careful livestock management can prevent overgrazing and maintain habitat for wildlife such as mule deer.

Patch burning is accomplished by applying spatially discrete fires to approximately one third of a management unit and allowing grazers free access to both burned and unburned patches. Livestock will focus grazing on recently burned patches until new patches are burned. When grazing shifts to higher quality forage on newly burned patches, patches previously burned have abundant forbs and begin to return to grass dominance. When patches return to grass dominance they are burned again, restarting the cycle. Landscapes with these distinct patches resemble the mosaic characteristic of historical grasslands and provide a diverse choice of habitats for wildlife that cannot be created by continuous grazing or rotational grazing within years. The appropriate frequency of fire in a patch burn landscape is dependent on climate.

Plantings

Seeding pasture and open areas with native grasses, forbs, and shrubs can provide mule deer with seasonal forage. As large-scale plantings can be costly, consultation with local NRCS personnel, as well as with representatives of other government agencies and conservation organizations involved in wildlife and land management issues, may be helpful in determining the most suitable choices for the species composition of new plantings most conducive to enhancing mule deer habitat in a given area. In addition to forage material, planting schemes should take other requirements into consideration, such as providing cover and fawning areas.

Woodland management

Burning

Controlled burning of woodlands can enhance mule deer habitat quality by promoting nutritious new growth and removing of excessive undergrowth, facilitating deer movement. Due to the inherent complexities of woodland burning, all fire management plans should be developed and implemented with the assistance of professional forest managers and licensed burners. Known fawning grounds should be avoided, as an abundance of debris is required for protecting newborn fawns from predators and the elements.

Selective timber harvest

Conducting uneven-aged timber harvesting on a rotational basis – 5 to 7 years for pines, 10 to 15 years for hardwoods – can be effective in maintaining stands of timber useful to mule deer by creating a mosaic of forested, open, and edge habitat preferred by deer. Canopy gaps created by selective tree harvest encourage the growth of understory forbs, shrubs, and grasses consumed by mule deer. Cutting mast pro-

ducing trees, such as oak, maple, and ash species that produce nuts, berries, and seeds, should be avoided. Snags, or dead trees that contain nesting cavities, should also be allowed to remain, as they provide habitat for many forest species.

Maintaining plant diversity is essential, as a highly species-diverse forest provides greater forage opportunity for animals; in other words, wildlife diversity is often correlated with vegetation diversity. As such, clearcutting should be avoided, as uneven-aged forest stands offer a greater degree of diversity than even-aged stands that result from large clearcuts. During thinning operations, leave patches of unthinned or overtopped trees to provide additional habitat diversity. Disturbance of riparian areas should be minimized or avoided altogether to maintain water quality, bank stability, and prime wildlife habitat. Human disturbance should also be kept to a minimum; forest roadways, for example, should be closed to human use wherever feasible. Consult with professional forest managers, wildlife biologists, and other woodland management experts for assistance in the development and implementation of forest management plans.

Conflicts

Mule deer can pose threats to both property and personal safety. Browsing on ornamentals, crops, and nursery plants can be extremely costly to property owners, while deer-automobile collisions may result in millions of dollars in damages, as well as injury and death. On average, 7,000 deer collisions are reported annually in Colorado alone, costing a reported $3 million in vehicle damage. High fencing, electric fencing, tethered dogs, and noisemakers may aid in deterring habituated deer, while repellents such as tallow-based soaps, predator urine emulators, and the selective planting of unpalatable plants may deter unwelcome browsing.

Lynn Betts, NRCS

Selective harvest is a common forest management practice used to create or improve mule deer habitat.

Fences are probably the most cost-effective means of dissuading mule deer from entering a property. However, mule deer can become entangled in fencing if not constructed properly. As a general rule of thumb, fencing should be approximately 6 to 8 feet high and constructed of woven wire, higher (~10 to 11 feet) on sloping ground or areas of high snowdrift. Barbed wire should not be used at any time.

Available assistance

Landowners interested in making their individual efforts more valuable to the community are invited to work with the Wildlife Habitat Council and NRCS to involve local school, scout, and community groups and their families, as well as State and Federal fish and wildlife agency personnel, in habitat projects when possible. Onsite education programs demonstrating the necessity of mule deer habitat management can greatly increase the value of an individual management project. Corporate landowners should encourage interested employees to become involved. Involving Federal, State, and non-profit conservation agencies and organizations in the planning and operation of a mule deer management plan can greatly improve the project's success. Assistance programs available through various sources are listed in table 5.

Conclusion

Mule deer are large, adaptive animals that require several basic habitat components. A mix of open areas replete with edible forbs, grasses, and shrubs in close proximity to relatively large stands of woodland and brush provide cover for both predator evasion and thermal protection, and an accessible source of water constitute the predominant features of suitable mule deer habitat. Private landowners can provide quality habitat for mule deer by incorporating deer habitat requirements into land planning. Managing for the inclusion of mule deer habitat requirements will also benefit associated wildlife that depend on similar environments. Managing grazing, conducting selective timber harvest and periodic burns, providing a dependable source of water, and planting native species are some of the options that landowners may consider to benefit mule deer populations.

Table 5 Financial and technical assistance available to landowners with habitat projects

Program (CRP)	Land eligibility	Type of assistance	Contact
Conservation Reserve Program (CRP)	Highly erodible land, wetland and certain other lands with cropping history. Streamside areas in pasture land	50% cost-share for establishing permanent cover and conservation practices, and annual rental payments for land enrolled in 10- to 15-year contracts. Additional financial incentives available for some practices	NRCS or FSA State or local office
Environmental Quality Incentives Program (EQIP)	Cropland, range, grazing land and other agricultural land in need of treatment	Up to 75% cost-share for conservation practices in accordance with 1- to 10-year contracts. Incentive payments for certain management practices	NRCS State or local office
Partners for Fish and Wildlife Program (PFW)	Most degraded fish and/or wildlife habitat	Up to 100% financial and technical assistance to restore wildlife habitat under minimum 10-year cooperative agreements	U. S. Fish and Wildlife Service local office
Wildlife Habitat Incentives Program (WHIP)	High-priority fish and wildlife habitats	Up to 75% cost-share for conservation practices under 5- to 10-year agreements	NRCS State or local office
Wildlife at Work	Corporate lands	Technical assistance on developing habitat projects into programs that allow companies to involve employees and the community	Wildlife Habitat Council

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