MULE DEER

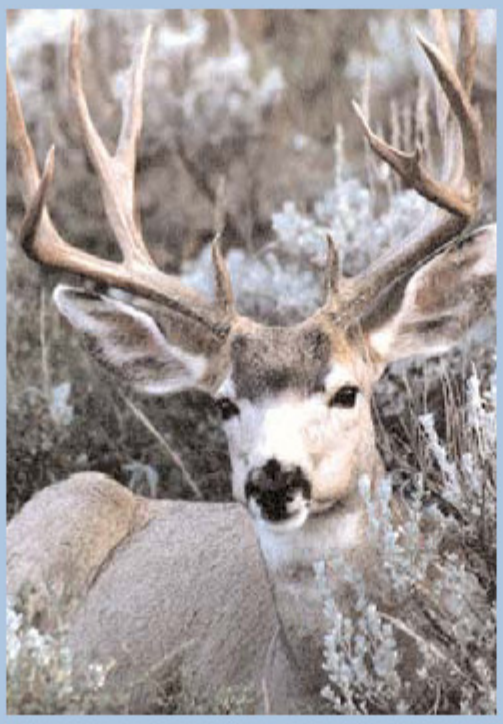
Changing Landscapes, Changing Perspectives

A Publication by the Western Association of Fish and Wildlife Agencies Mule Deer Working Group

Since 1922, the Western Association of Fish and Wildlife Agencies (WAFWA) has served as a leader promoting management and protection of fish and wildlife in the western United States and Canada. An organization represented by 17 states and four Canadian provinces, WAFWA has faced the difficult challenge of sifting through the ever-changing societal, economic, political and scientific issues that define natural resource management in a West that has undergone many changes.

WAFWA is particularly concerned about mule deer, a species that lives in every North American habitat except for the tropics, arctic and extreme deserts. Mule deer numbers and distribution have been declining throughout the West since the latter third of the 20th century.

To address this concern, the Mule Deer Working Group was established at the midwinter meeting of WAFWA in 1998. The group was charged with finding "solutions to our common mule deer management problems," expanding "cooperative research and management in the Western states and provinces,' and sharing information with agency directors and administrators on mule deer issues.



To achieve its goal, the working group set out to improve communication about mule deer, and make it easier for agencies to share information on mule deer management and research.

Mule Deer in the West, Changing Landscapes, Changing Perspectives, is one of the outcomes of the working group. The goals of this publication are to share research and technical information on mule deer in an easy-to-read format, and to generate informed discussion on a species that defines the West and is of tremendous importance to many people.

This publication sheds light on the single greatest factor that has caused declines in mule deer - loss and degradation of habitat. It offers an overview of mule deer, and looks at ways deer, elk, livestock and people interact. Feature articles expose issues affecting mule deer populations such as fire, disease, changes in habitat and predator-prey relationships, and the challenges biologists face in surveying big game animals. It explores a concept called adaptive resource management, a relatively new method of managing wildlife throughout the world.

It concludes with a look to the future, and offers additional sources of information for you to learn about mule deer.

It is our hope that this publication builds a foundation to generate informed discussion, and enhances understanding of the competing promises and visions for responsible management of mule deer.

WAFWA Mule Deer Working Group

Founded in 1922, WAFWA currently has 21 member organizations:

- Alaska Department of Fish and Game
- Alberta Department of Sustainable Resource Development, Fish and Wildlife Division
- Arizona Game and Fish Department
- British Columbia Ministry of Water, Land & Air Protection, Biodiversity Branch and Fish and Wildlife Recreation and Allocation Branch
- California Department of Fish and Game
- Colorado Division of Wildlife
- Hawaii Department of Land and Natural Resources
- Idaho Fish and Game Department
- Montana Department of Fish, Wildlife and Parks
- Nebraska Game and Parks Commission
- Nevada Department of Conservation and Natural Resources
- New Mexico Game and Fish Department
- North Dakota Game and Fish Department
- Oregon Department of Fish and Wildlife
- Saskatchewan Department of Environment and Resource Management
- South Dakota Game, Fish and Parks Department
- Texas Parks and Wildlife Department
- Utah Division of Wildlife Resources
- Washington Department of Fish and Wildlife
- Wyoming Game and Fish Department
- Yukon Department of Environment, Fish and Wildlife Branch

WAFWA Mule Deer Working Group

- Warren Ballard - Texas Tech University
- Lou Bender - Washington Department of Fish and Wildlife
- Lew Carpenter - Wildlife Management Institute
- Mike Cox - Nevada Department of Conservation and Natural Resources
- Steve Crumey - Utah Division of Wildlife
- Jim deVos - Arizona Game and Fish Department (Chair)
- John Ellenberger - Colorado Division of Wildlife
- Glenn Erickson - Montana Department of Fish, Wildlife and Parks
- Bill Glasgow - Alberta Department of Sustainable Resource Development
- Barry Hale - New Mexico Game and Fish Department
- Ian Hatter - British Columbia Ministry of Water, Land & Air Protection, Biodiversity Branch
- Jim Heffelfinger - Arizona Game and Fish Department
- Tom Keegan - Oregon Department of Fish and Wildlife
- Matt Kirchhoff - Alaska Department of Fish and Game
- Daryl Lutz - Wyoming Game and Fish Department
- Bruce Morrison - Nebraska Game and Parks Commission
- Jerry Nelson - Washington Department of Fish and Game
- Jim Unsworth - Idaho Fish and Game Department
- Brian Wakeling - Arizona Game and Fish Department

Mule Deer, Changing Landscapes, Changing Perspectives, is a series of non-technical articles based on technical papers from the book, "Mule deer in the West – The View in 2002."

This publication was produced and edited by Creative Resource Strategies, West Lian, Oregon.

Publication Design by Frey Design of Portland, Oregon

What's in a Name?

Looks aren't everything, but if you're a deer in the West, looks play an important role in determining whether you're called a mule deer, black-tailed deer or white-tailed deer. Behavior and habitat contribute, as well.

Species and Subspecies

Subtle variations in characteristics such as size, behavior and appearance in deer occur because of local habitat, food or weather conditions. There have been as many as 11 subspecies of mule deer and 30 subspecies of white-tailed deer described – all of these subspecies belong to two recognized species of deer in the West; mule deer and white-tailed deer. Black-tailed deer are also found in the West, but they are actually a subspecies of mule deer. All deer are members of the Cervidae family, hoofed mammals that have antlers such as elk, moose and caribou.

Mule deer were first described in North America in 1817 based on field notes made by Charles Le Raye while he was held captive by the Sioux tribe on the Big Sioux River in South Dakota (see sidebar article). The scientific name of the species, hemionus, literally means "half-mule," because the ears are similar to those of a mule.

Differences Between Species

There are several ways to tell a mule deer from a white-tailed deer, a critical need for hunters who must be able to identify species in areas where both exist. Mule deer differ from white-tailed deer in several ways, but because of variation within each species, some mule deer and white-tailed deer cannot be quickly identified. Black-tailed deer further cloud the identification issue because they display characteristics similar to both white-tailed deer and other mule deer subspecies.

When used alone, some of the identifying characteristics can be confusing. Thus, it is important to use several characteristics to identify species.

Mule deer (foreground) and white-tailed deer (background) foraging together. Note the difference in metatarsal glands and tails. By Pat O'Brien.

Tails

White-tailed deer have a wide, flattened tail that is broad at the base and narrower at the tip. A darker backside contrasts the pure white underside. The darker tail is edged with white fringe hairs that are an extension of the white underside. White-tailed deer lack a large, conspicuous white rump, and have tails that are at least 7 1/2 inches long.

Mule deer tails appear cylindrical, or rope-like, and are usually white on the backside, with a distinctive black tip surrounded by a large, obvious white rump. Some mule deer may have a thin dark line running down the back surface of the tail. Mule deer tails are less than 7 1/2 inches long.

Mule Deer

White-tailed Deer

Antlers

Antlers are the least reliable characteristic to use when trying to differentiate mule deer from white-tailed deer because of the variation in antler shape and form in both species. Antlers can, however, help identification when used in combination with other characteristics.

Mature mule deer bucks have antlers with main beams that sweep outward and upward, forking once and then forking again. Brow tines are not always present. Mature bucks typically have eight to 10 total points (including brow tines that exceed one inch). These bucks are considered 4-point bucks (the number of points on one side of the rack excluding the brow tines).

Typical white-tailed deer antlers have several antler tines that arise singly off a main beam that sweeps outward and forward from the bases. The brow tines are nearly always present and usually prominent. Mature white-tailed deer bucks frequently have eight total points, including the brow tines.

It is not unusual for white-tailed deer to have forked tines like those of a mule deer, or for mule deer tines to arise from the main beam like those of a white-tailed deer. Mule deer bucks less than three years of age are frequently mistaken for large white-tailed deer because the tines have not yet developed the characteristic fork.

There may also be regional differences in antler form. For example, the white-tailed deer in the Carmen Mountains of northern Mexico seem to have a high degree of forked antlers like a mule deer.

Facial Markings

The forehead of a white-tailed deer is usually the same color as the rest of the face, although it can be slightly darker. The white eye rings and markings directly behind the nose are prominent.

A mule deer usually has a distinctive black forehead, or mask, that contrasts sharply with a light grey face. The lighter facial coloration makes the eye rings and muzzle markings seem less obvious.

Ears

White-tailed deer ears are generally 2/3 the overall length of the head (back of head to nose), while those of a mule deer are 3/4 the length of the head.

Alarm Behavior

When alarmed, a white-tailed deer usually raises its tail, exposing the fluffy white underside to alert all other deer in the area of apparent danger. It then runs directly away from the source of danger.

A mule deer does not "flag" its tail, and often bounces away in a motion called "stotting," in which all four hooves push off the ground at the same time. A mule deer may not escape as fast as a white-tailed deer, but a mule deer is more effective in quickly moving through rugged terrain.

Both species may stop and look back at the source of potential danger, but this behavior is more typical of mule deer.

Metatarsal Glands

The best way to tell a white-tailed deer from a mule deer is the size and location of the metatarsal glands, but this is not a readily observable characteristic. The metatarsal glands of both species are located on the outside of the lower portion of the hind leg, and are sometimes confused with the tarsal gland on the inside of the leg (hocks).

White-tailed deer have metatarsal glands that are one inch or less in length, and always encircled with white hair. This gland is at midpoint or below midpoint on the lower shank of the leg.

Mule deer have much larger metatarsal glands that are encircled with white hair. The gland measures three to seven inches in length, and starts at the ankle joint and extends downward toward the hoof. It appears as a large, long tuft of hair.

There are regional differences in metatarsal glands within species. For example, metatarsal glands of mule deer in desert habitats are reported to be shorter than mule deer in more northern habitats.

Preorbital Glands

The preorbital ("pre" means "in front of", "orbital" means "eye") gland is located in front of the eye and differs considerably between the two species. The preorbital gland of a white-tailed deer is very small, appearing as a small slit with a maximum depth of 3/8 inch. The preorbital gland of a mule deer is comparatively large, forms a substantial pocket with a depth averaging 3/4 inch, and commonly contains a small ball of yellow, waxy substance.

Hybrids

When two species breed, the offspring is called a hybrid. Different species of animals normally do not breed with one another because they use different habitats, or are geographically isolated. If similar species live in the same habitat, then they generally breed at different times or have different breeding behavior.

In the case of white-tailed deer and mule deer, courtship and breeding behavior are different enough that body language and scent cues from a female mule deer during rut are not normally "understood" by a white-tailed deer buck, and vice versa. In some cases where ranges overlap, this system breaks down and mule deer and white-tailed deer may mate and produce a hybrid deer.

Mule deer x white-tailed deer hybrid harvested by Rudy Alvarez in southeastern Arizona. Confirmed to be a hybrid using genetic analysis at the US Fish and Wildlife Service Forensics Laboratory in Ashland, Oregon. By Jim Heffelfinger.

Hybrid deer may have characteristics of both mule deer and white-tailed deer. But a young mule deer may look like a large white-tailed deer, especially if its tail has a dark stripe down the back.

Every year numerous hunters report seeing hybrid deer, however, it is unlikely a hunter will ever see a hybrid deer in the field. The low number of white-tailed deer that mate with mule deer, and the low survival rate of hybrid offspring, greatly reduces the chance of encountering a true hybrid in the wild. Hybrids are rare and difficult to accurately identify because of many varying characteristics.

Of Shipwrecks and Captives – A Name in the Making

Giving an animal a scientific name doesn't sound like the stuff movies are made of, but the story behind the genus and species of mule deer includes tales of a shipwreck and a trader held hostage by Native Americans.

A naturalist that lived in the 19th century is credited with giving mule deer their scientific name, Odocoileus hemionus (Odocoileus means hollow tooth, while hemionus means half-mule). Constantine Samuel Rafinesque (1783-1840) was traveling from Sicily to the United States in 1815 when his vessel shipwrecked off of Long Island Sound. Rafinesque settled in North Carolina, where he read the journals of a Canadian trader named Charles Le Raye who was held captive for almost 14 years by a party of Native American Sioux. The journal contained a wealth of information on natural resources and geology from the Midwest to the West Coast.

In his journals, Le Raye described "A kind of deer (on the Sioux River), called mule deer. It is smaller and of a darker colour than the red deer, having large branched horns. The ears are very large, the tail about five inches long with short dark hair, and at the end a tuft composed of long black hair."

Rafinesque called this "new" species, Cervus hemionus, and likened it to a relative of the already named "black tail deer," Cervus melanurus.

At the time, Rafinesque classified mule deer and black-tailed deer as different species, but today they are recognized as different forms (subspecies) of the same species.

Sketch of Rafinesque from The Kentucky Encyclopedia, The University Press of Kentucky, Lexington.

The West that Was... No Longer Is

Europeans began settling the West a mere 150 years ago, a drop in the geological bucket of time. The streaming of settlers westward created big changes on the landscape, as land was planted to row crops and grazed by livestock. Although no accurate way to estimate mule deer populations was available at the turn of the century, accounts of their presence indicate numbers were very low.

Hunting regulations, increased law enforcement, creation of wildlife refuges such as the Grand Canyon National Game Preserve, and improvements in wildlife habitat and predator management resulted in a collective explosion of mule deer herds, with population estimates totaling 2.3 million in 1950. The 1950s and 1960s were considered the "hey days" of mule deer populations.

The population highs of the 1950s and 1960s were followed by sharp declines in mule deer numbers. Biologists don't believe there is one silver bullet that explains the declines in both numbers and distribution of mule deer. What biologists know is that the many changes that have taken place across large landscapes result in fewer mule deer that can call the West home.

Chris Madson, Wyoming Game and Fish Publications Supervisor and Editor of Wyoming Wildlife Magazine, included some of these issues in an essay titled, "The Quiet Crisis" in the September 2001 issue of Wyoming's magazine.

"The problems facing wildlife and wild places in North America are deeper and more complex than they have ever been before, but their root causes attract little attention," said Madson. "All of us who care about wildlife face a challenge of unprecedented dimensions, an emergency that western conservationist and statesman Stuart Udall once called the quiet crisis."

The quiet crisis began with the settling of the West. After livestock were introduced into the Great Basin in the 1860s, native bunch grasses were overgrazed and replaced by sagebrush. A severe winter in the late 1800s decimated many livestock herds and wildlife populations. This was followed by an abundance of wildfires and about seven wet years in the Great Basin, which led to the widespread establishment of bitterbrush, a high quality preferred food of mule deer.

The increase in quality and quantity of plants preferred by mule deer caused mule deer populations to rebound by 1950. During the 1950s, biologists noted fawn:doe ratios of 75 to 100, or even 100 to 100, something that is unheard of in many places in the West today.

Then some of the quiet crisis factors kicked in, resulting in greater competition for natural resources and a lesser ability of the land to support large numbers of mule deer.

These include:

1. Habitat changes caused by fire suppression, invasive plants and livestock management have lessened the ability of habitats to support mule deer populations.

2. Gas, mineral and oil exploration fragment habitat and continue to threaten important traditional mule deer range.

3. Predators play a shifting role as habitat loss and urban sprawl concentrate mule deer populations on smaller tracts of land near human populations.

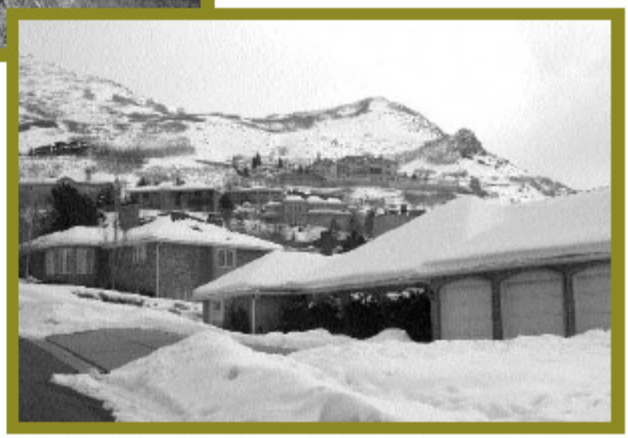
4. Climatic changes such as drought and severe winters play a key role in quality and quantity of habitat, and the ability of mule deer young to survive one year to breeding age.

5. Habitats are fragmented and lost as a result of human population growth and development in traditional summer and winter mule deer range.

6. Interactions with elk may increase when habitat is poor or limited.

Today, virtually every ecoregion has a lesser ability to produce and maintain mule deer when

Riparian area in Great Plains Ecoregion. By Steve Knapp.



Housing is most of the remaining winter range along Wasatch Front, SLC. By Steve Cranney.

A combination of fire suppression, oil-gas-mineral exploration and mining, predation, habitat fragmentation, spread of invasive plants, drought, competition between species, livestock management and other human factors such as urban development have affected the habitats of mule deer.

compared to the mid-1950s. The term biologists give to the amount of food, water and cover an area can support is carrying capacity.

Carrying capacity can be likened in simpler terms to the amount of clothes a suitcase will hold. You can fill a suitcase, but at some point, there is no room left for additional items. Habitat is much the same way. Land cannot support the numbers of mule deer it once had if the quality habitat doesn't exist to provide food, cover, water and shelter to those animals year-round.

On a landscape scale, mule deer populations have not recovered since habitat began declining in the latter half of the last century. And realistically, unless the human population stops growing and habitat loss and degradation ceases, people are facing a West that will continue to look much different from the one that existed during the mule deer "hey days." And this land will more than likely contain fewer mule deer.

"Removing fire has had a dramatic effect," said Mayer. "We've taken fire out of the ecosystem in the forest environment. When we finally get a big fire, 2-4-D (a herbicide) is sprayed to kill the shrubs, then it's planted to trees. That eliminates early successional stages."

Ken Mayer, Chief of the Scientific Branch for Oil Spill Prevention and Response with the California Department of Fish and Game, and co-author of "A Sportsman's Guide to Improving Deer Habitat in California," offered several insights to habitat changes after his lengthy tenure as a deer biologist for California Fish and Game. He said that while many factors have caused mule deer declines, fire suppression and conversion of shrub-scrub habitats have literally changed the face of the landscape.

A stand of cheatgrass that resulted from a 2001 wildfire, showing the skeletons of dead sagebrush plants that will not resprout due to the lack of moisture at this elevation. By Mike Cox.

Early successional stages commonly have young forbs and shrubs that are high in protein, very nutritious and within the reach of mule deer. Later successional stages can provide cover for mule deer, but generally provide poor habitat because of the lack of food present.

On a very large scale, there are fewer habitats in early successional stages than there were 50 years ago. Mayer referred to a research study on mule deer food habits in 1954. "Ninety percent of the diet of mule deer was shrub component, with the remainder herbs and grasses," said Mayer. "We did the same study again in 1994 and we got 80 percent herbaceous material in the diet. That shows what is happening to our ranges. You can't support large numbers of deer on grasses."

Mayer predicts it will be impossible to return to the mule deer population levels of the 1950s and 1960s.

"I don't think it's feasible from a resource habitat perspective or a political perspective," said Mayer. "There's a hell of a lot more people living in places like Colorado and California than the 50s and 60s, and we're converting habitat at a high rate."

If it isn't possible to mule deer numbers that existed in the mid 1950s, then what is possible?

- *It is possible to manage mule deer populations at optimum levels given existing habitat conditions, and to work hard to manage the factors that limited mule deer populations over the past half century.*
- *It is possible to maximize the benefits to wildlife from development of all kinds.*
- *It is possible to restore habitats on a large scale to improve the ability of existing habitats to support mule deer and offset habitat loss.*

Mayer said it is especially important to manage public perspective.

"If we're really going to change things, we need to change the perspective of the public regarding what a healthy forest ecosystem is," said Mayer. "The public has a perception that a forest is trees. But a forest is really a variety of things, from grasses and forbs to old growth."

The Sierra Nevada Story

George Gruell, a retired wildlife biologist from the U.S. Forest Service, compared landscape photos from the late 1800s and early 1900s to recent times of the Sierra Nevada is his book, "Fire in Sierra Nevada Forests." His photographic essay is a mule deer's nightmare.

The Sierra Nevada is a 15.5 million acre chunk of land that spans 360 miles north to south from California's Central Valley to 50 plus miles east. Elevations range from sea level to 14,000 feet, and annual precipitation ranges from 20 to 75 inches.

Gruell's goal was to identify the factors that have caused landscape changes. He noted that the health of the forests and habitats are declining, and that excessive fuel loads, a direct result of widescale fire suppression, make many areas susceptible to catastrophic fires. Gruell said changes in climate, livestock grazing, logging and fire have been the biggest agents of change in the Sierra Nevada. The end result, he concludes, is a dense forest with much less wildlife habitat.

The future of the Sierra Nevada may be bleak for wildlife and people if public opinion about management of the landscape does not change. Gruell believes it is possible to improve the landscape of the Sierra Nevada for people and wildlife, but only if fire is restored to the ecosystem.

Is the habitat situation in the Sierra Nevada unique? Hardly. While this example is specific to California, each of the mule deer ecoregions has been subjected to many factors that have lessened the ability of western landscapes to provide homes for deer and other species of wildlife.

Biologists have taken an in-depth look at each of the factors contributing to mule deer declines, and offer suggestions to improve habitats that support not only mule deer, but many western wildlife populations.

1

Losing Ground

Fire, invasive species and livestock management have changed western landscapes

Fire

Of all the factors that have shaped the ecoregions in which mule deer exist, fire has been the strongest one with the greatest positive influence. Fire is a critical force in maintaining and creating habitat for mule deer because fire sets back succession.

Succession is the orderly and progressive replacement of one plant community by another until a fairly stable community occupies an area. If left alone, an abandoned crop field will not remain in that state for very long. Generally, grasses, forbs and weeds will begin to grow, followed by brushy plants, then by saplings that invade open areas, until the site is finally occupied by a stand of trees. Historically, fire has been the most effective tool in maintaining grasslands across the United States. Today, it is still considered to be the most important tool a biologist has to manage habitat.

A quick peak at national historical wildfire data provides insight into the frustration land managers face with fire suppression efforts.

Decade	Number of acres burned
1920s	26 million acres
1930s	39 million acres
1940s	23 million acres
1950s	9 million acres
1960s	4 million acres
1970s	3 million acres
1980s	4 million acres
1990s	3.6 million acres

Since the decade of the 1940s, fires have not burned in double digit numbers in the United States. Wyoming Game and Fish Biologist Steve Kilpatrick attributes the heyday populations of mule deer in the middle of the 20th century to the quantity and types of fires that burned in the decades prior to the 1950s.

"In the 1920s through 1950, we had some massive burns and resprouting shrubs," said Kilpatrick. "We had high quality browse, and a lot of quantity - lots of acres of good (mule deer) groceries. Browse was nutritious, young, palatable and easy to digest." Now the plants are older, and when it rains or they are browsed, they don't respond as vigorously.

Forest fire. By Gary Schafer

In addition to fewer fires burning on fewer acres, fire suppression has changed the intensity and rate at which fires burn, resulting in different and unpredictable communities of plants. Fuel loads build up such that when infrequent fires occur, they cover large amounts of land and burn very hot. A recent example of that is the Rodeo fire near Pinedale, Arizona, that burned at 2,000 degrees Fahrenheit. In general, areas that burn fast and hot become monocultures, in which there are fewer types of plants that are similar in age.

Daryl Lutz, Wildlife Management Coordinator for Wyoming Game and Fish in Casper, said that lack of fire is creating overaged less useful aspen and sagebrush stands.

"On mule deer summer range, aspen communities are being lost at an alarming rate due to natural vegetative succession," said Lutz. The reason these habitats are being lost is lack of fire.

"In an aspen stand, you can see a vegetative response within one or two years of a fire," said Lutz. But some plant communities do not respond as quickly. Lutz said, "In a sagebrush stand, it could be up to twenty years."

Lutz emphasized the importance of creating patterns of habitat.

"Whenever we do things in sagebrush communities, we always emphasize and tailor our prescriptions to a mosaic of burned and unburned," said Lutz. "We're starting to evaluate how we should be doing prescribed burning so we don't eliminate brood rearing or nesting habitat for sage grouse, and help other species."

Ken Mayer of the California Department of Fish and Game emphasized the changes that happen to a landscape over time if small, cool, frequent fires are replaced by large, hot, infrequent fires.

"Hot fires burn minerals from the soil, and you don't get the regeneration you should," said Mayer. This lessens the potential of the site to be productive, and ultimately results in long-term changes to the habitat.

"In alpine communities, there is about a three month growing season," said Mayer. "In some of that country, the snow doesn't come off until July. The plants have a short window to grow, and have adapted to fires over a long period of time. If you eliminate fire, then introduce fire in a big way (a large, hot, intense fire), it takes 10 years for those plants to become useful for mule deer again."

Kilpatrick echoed the consequences of large, hot fires. "Mother Nature says you can pay me now or you can pay me later with interest," said Kilpatrick. "Suppressed fires will be a lot larger, and the intensity and severity will be greater when they do burn. Wildlife love resprouting shrubs. But fires that burn hot can kill resprouting species of shrubs. It's quite a while before the moonscape appearance disappears. We're exacerbating the situation by our actions."

Mule deer thrive in early successional habitats, where forbs, grassy plants and shrubs dominate. These environments are not as stable as forest habitats, and they rely on fire or some other type of disturbance to return them to an early successional stage. If they are not disturbed, they eventually become more stable plant communities dominated by trees and large shrubs. Tree-dominated habitats offer mule deer a place to retreat from severe weather, but these areas offer very little in the way of food. That is why it is important to provide mule deer with a mosaic or pattern of habitats that can provide food, cover and water.

Arizona Game and Fish Department's Chief of Research Jim deVos said large, hot fires contribute to soil erosion.

"Another problem associated with the catastrophic fires that are occurring due to long-term fire suppression is that virtually all of the vegetation is lost, which increases soil erosion," said deVos. "It is important to remember that it took eons to build the top soil layer, and its loss will alter the lands' ability to rebuild. Where this occurs, the land may never recover its capacity to support wildlife populations as it did before these incredibly intense fires."

To complicate matters, habitats with plant species such as mountain big sagebrush are experiencing fires every 100 or more years compared to pre-European settlement fire frequencies of 12-25 years. Wyoming big sagebrush, a habitat with large amounts of the invasive plant, cheatgrass, is now subjected to fires every 10 years instead of every 50 to 100 years. Drastic changes in fire frequency may result in changes in the types of plants found in a given area.

Kilpatrick said that drought years compound the problem, making it more difficult for biologists to use prescribed fire.

"We're using prescribed fire as much as we can, but it's more difficult to use during these drought years because of the risk factor," said Kilpatrick. "It takes someone that can find the dotted line to say they'll be responsible for doing prescribed burns in a risky situation. But fires normally burn twice as many acres in drought years."

Kilpatrick said land managers are behind the curve burning on a landscape scale, especially compared to the amount of land that used to burn on an annual basis.

Kilpatrick said federal agencies responded to the Yellowstone Fire in the late 1980s with a strong educational effort, but that habitat change often occurs over the long-term, oftentimes longer than the life span of a human being.

"Fire was THE main player forming the very landscape that we cherish and want to protect now," said Kilpatrick. "People realize it's a dynamic system, be it ever so slow. For example, aspen needs a fire every 80-100 years. People don't see those changes taking place in their lifetime. But the public is accepting fire – they just don't want to see their homes burned down."

To avoid seeing homes burned, people are willing to pay a steep price. Suppression costs for wildfires are easily three to five times greater than the cost of prescribed fire per acre. In the last seven years, the cost of fire suppression for federal agencies has ranged from a low of $256 million in 1997 to a high of $1.36 billion in 2000.

According to Kilpatrick, the effects of fire suppression are worsened because of habitat fragmentation.

"You couple what has happened with fire, and compound winter range being used by urban sprawl, and then our exploration and development for oil and gas on winter ranges – it's fragmenting habitat," said Kilpatrick.

Burned sagebrush habitat from a wildfire that has regrown into exotic pant cover of mustard and cheatgrass in the foreground. The area in the middle of the picture was disced and planted with a mixture of native and nonnative seeds. The dark green hills in the background did not burn and contain native sagebrush. By Ken Gray.

As a result of these interactions, Kilpatrick said an emphasis should be placed on maintaining critical areas such as important winter ranges.

"We need to put as much management effort on important winter ranges, keep them unfragmented in terms of oil development and maintain high quality forages," said Kilpatrick.

Kilpatrick attributes increases in predation with habitat fragmentation.

"When you fragment the habitat, prey doesn't have the landscape to escape predators. Predators have a much easier time catching prey in reduced and fragmented habitat." He said the increased presence of predators such as mountain lions in suburbs is likely a direct result of the wildlife habitat that has been created at the urban interface.

"We're so far behind the curve in terms of a landscape scale that we'll never catch up with prescribed fire," said Kilpatrick. "Nature will catch us up, as she has during a drought."

Kilpatrick cautioned, "Don't blame the predators. They're the symptom, we're the problem."

Invasive Species – A growing threat

What harms 15 percent of our country's ecosystems, costs the United States at least $137 billion a year in lost profit and eradication efforts, and includes a group of about 7,000 species? The answer – invasive species. While many are found throughout the West, one of the most harmful is the winter annual grass called cheatgrass, alias downy brome.

Cheatgrass found its way to the United States from Europe and Asia in the late 1800s on the backs of livestock, and in some grain and hay feed. By 1920, it firmly established itself as a formidable invasive plant.

It is a plant species with few endearing qualities. Cheatgrass is not very nutritious or palatable to livestock and wildlife, although livestock will graze on it in some desert habitats in the winter and spring, and mule deer will browse on it in early spring.

When cheatgrass is present, livestock overgraze native plants, causing direct competition with mule deer for food. But that's not the worst of it. Overgrazing by livestock actually helps cheatgrass gain a foothold, both on the overgrazed land, and on nearby land where invasive plants may not have existed.

What gives cheatgrass the ability to outcompete native plants? John Grahame and Thomas Sisk, editors of "Canyons, cultures and environmental change: An introduction to the land-use history of the Colorado Plateau," a publication from the Center for Environmental Sciences and Education at Northern Arizona University, describe the unique ability of cheatgrass to outcompete native plants.

"Most native bunchgrasses of the Colorado Plateau are perennial, whereas annual plants like cheatgrass grow from a seed, then flower, set seed, and die every year. Cheatgrass usually germinates in fall and grows during winter, opposite the cycle followed by common native perennial grasses. By the time the rain stops in spring, cheatgrass already is maturing its seeds. Unlike native bunchgrasses, cheatgrass then dies by the end of July, avoiding the hottest and driest part of summer.

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"Dead cheatgrass burns easily, causing early and abundant wildfires which tend to damage or kill native grasses. During a fire, early-maturing cheatgrass seeds can take advantage of many nutrients the fire releases to grow large and produce abundant seed, over a thousand per plant in some cases.

"Because cheatgrass quickly develops a large root system in the spring, by the time native grass seedlings start to grow in April or May, cheatgrass has stolen most water out of the top foot of soil. Although mature native grasses can get water from lower soil regions, seedlings cannot get their roots deep enough into soil to access water before drought sets in, and thus, die of thirst. Without this ability to reproduce, native grasses inevitably decline, and so over time, cheatgrass becomes more and more common until eventually it dominates. Cheatgrass often opens the way for secondary invaders such as knapweed and thistle."

A strong invader like cheatgrass poses two threats to mule deer. Cheatgrass outcompetes native perennial forage, and increases the frequency and intensity of wildfires, altering the quality of sagebrush habitat.

When cheatgrass takes hold, it can ultimately outcompete every native plant, creating a monoculture, or a stand of plants that contain one or a few species. Except for the brief period in spring when new green shoots of cheatgrass emerge from the soil, stands of solid cheatgrass have about as much benefit to mule deer as a paved parking lot.

Cal McCluskey, Bureau of Land Management (BLM) Senior Wildlife Specialist, said cheatgrass is altering large tracts of land in the West.

Vast stands of cheatgrass cause frequent, large fires, much to the detriment of mule deer habitat. Intense frequent fires destroy native shrubs such as antelope bitterbrush, an important food for mule deer.

What is being done about the continued threat of invading plants?

The BLM is taking aggressive steps to learn more about the spread of invasive plants and large-scale landscape changes that have occurred since European settlement. And they're developing new and different approaches to combat nonnatives.

"Cheatgrass has created a fire cycle that has altered substantially the historical fire cycle," said McCluskey. "It has increased the frequency of fires, and in many areas, once the landscape gets burned two or three times, it often comes back in a monoculture of cheatgrass, just prime for burning again and again."

McCluskey said the Columbia River Basin and Great Basin are of particular concern to the BLM.

"Those are the two ecoregions that have had the greatest invasion problems with cheatgrass and other annuals like Medusahead," said McCluskey.

McCluskey said an effort is underway in the BLM to get a better handle on the extent of change on the landscape within the sagebrush ecosystem.

"We have a major effort underway to look at sagebrush habitat throughout its range, but particularly as it relates to sage grouse," said McCluskey. "We're working with the United States Geological Survey to put together a map of sagebrush for the entire West to show current versus historical distribution."

Other large-scale efforts are underway, as well. The BLM is leading the Great Basin Restoration Initiative, an interagency effort to restore areas burned by fire. Reseeding and changing grazing practices are two possible restoration strategies.

"The catalyst for that initiative was the bad fire year of 1991 in the Intermountain West," said McCluskey. "Several million acres burned, some of which was significant mule deer winter range."

Through the Great Basin Restoration Initiative, the BLM in Nevada is cooperating with state and local agencies and nonprofit organizations to restore and maintain native plant communities, and slow or stop the spread of invasive plants on about 10 million acres of public land.

McCluskey also talked about the BLM being the biggest landowner of sagebrush habitat in the West, and the importance of using fire to manage sagebrush.

"We have a major fire rehabilitation program to go back into areas that burn and reseed," said McCluskey. "State wildlife agencies provide the native seed and bare root stock. We target the areas with the highest probability of success."

Reducing the size and frequency of fires by creating fire barriers such as green strips is another effective strategy on the rise in the BLM.

"We've had some success with planting firebreaks using green stripping. We're planting them with perennial grasses that green up later and stay green long after the cheatgrass is cured," said McCluskey.

The BLM has another tool to fight invasive plants. Use of chemicals such as pre-emergents may prevent cheatgrass from germinating, lessening its ability to outcompete natives.

McCluskey emphasized there is no one solution to control the spread of cheatgrass, or to improve habitats that have been invaded by cheatgrass.

"It's a combination of treatments," said McCluskey. "There is no panacea."

What does the future hold for wildlife habitats? McCluskey said it's important to look at what's happening on a very large scale.

"We're caught between a rock and a hard spot from our program perspective," said McCluskey. "We're grappling internally with this in our agency. There's this Jeckyll and Hyde personality with a minerals mission on one side and a wildlife conservation mandate on the other side." That conflict makes land use allocation and management very challenging.

Understanding how sagebrush communities have changed over time and the management actions needed to restore these important habitats are keys to lessening the threat of invasive plants and restoring lands critical to mule deer survival.

Livestock management

Livestock management on western lands could be characterized as good, bad and ugly. Fortunately for mule deer, there's a whole lot of good going on.

Utah Division of Wildlife Resources Big Game Coordinator Steve Cranney has seen elements of all three on lands in and around Utah and the West. But overall, Cranney is very positive about using cattle to manage wildlife habitat – if it's done correctly.

"From our standpoint, livestock grazing has a lot of positives and negatives," said Cranney. "When you do it right, it does have its use."

Well-managed livestock grazing can improve the types and quantities of desirable plants, and maintain and create much-needed openings in dense habitat.

Cranney said his agency uses intense spring grazing on a number of wildlife management areas in big game winter ranges to graze grasses, and maintain and encourage growth of mule deer browse species.

"In the spring, cattle concentrate on the grass species, where the succulence is in the vegetation," said Cranney. "Spring grazing encourages the growth of browse species such as sage and bitterbrush. The cattle are on the ground only for a month to a month and a half in the spring – strictly in the spring."

Cranney said he varies how he uses cattle each year, depending on the status of the habitat, and the vegetation response he would like to see. He said his agency would use grazing even if it had the ability to use fire at any time because several plant species on deer winter range don't respond favorably to fire, particularly sagebrush.

Cranney said, "We can't just torch all winter range areas. Some browse species such as mountain mahogany and oakbrush respond favorably to fire, but sagebrush does not. How bitterbrush responds depends on the intensity of the fire. Spring grazing can be a valuable tool on many winter ranges."

Cranney commented that spring grazing has other benefits, as well. It helps the local ranching community while helping mule deer.

"We enter into agreements with ranchers that help us," said Cranney. "Spring grazing is very valuable to livestock people, too, because their cattle have been on hay all winter, and the ranchers are anxious to get their cattle off their ground so they can plant."

Livestock grazing sounds like a win-win-win situation for state wildlife agencies, ranchers and mule deer. The bad and the ugly side come into play when livestock are not managed properly.

Poor livestock grazing practices can help spread invasive plants, interfere with plant succession, reduce nitrogen in the soil, and change the plant community. And improper livestock grazing in and around riparian areas may harm the stream and the rich diversity of wildlife that thrive in these environments. Overgrazing reduces water quality, changes stream flow, compacts and erodes soil, and affects native plants and animals that live alongside and in streams.

Tom Fleischner, in his 1994 Conservation Biology article, "Ecological costs of livestock grazing in western North America," said that livestock grazing has had "the most severe impact on one of the biologically richest habitats in the region," and states that, "much of the ecological integrity of a variety of North American habitats are at risk" because of poor grazing practices.

What kind of risk? Cottonwood/willow forests along arid western streams have declined about 90 percent since pre-settlement times. A 1988 report on "Restoring Degraded Riparian Areas on Western Rangelands" noted that "those narrow bands of green adjoining rivers, streams, and lakes, are crucial to the ecological health of arid western rangelands."

Cranney commented that cattle do the most harm in riparian areas.

"If they're not fenced out, then they camp on it," said Cranney. "The woody species and stream bank cover in riparian areas get taken out." Cranney said this can be a serious problem, especially in states like Utah that are dry, and have limited riparian areas.

The good news is that the bad and ugly can be avoided. How can land managers manage livestock grazing for the benefit of people and wildlife? By establishing a sound range management program based on good range science and tailored to the local area. A good range management program should have the following elements:

1. *Conduct prescribed burns to improve plant quality.*
2. *Do not graze stressed rangeland.*
3. *Control the number of livestock on rangeland to prevent overgrazing. Some ranchers recommend stocking at a rate less than 70 percent of average rainfall carrying capacity.*
4. *Use rotation grazing to prevent intensive spot grazing.*
5. *Fence riparian areas and provide off stream watering sources.*

Cranney said state of the art wildlife management includes managing riparian areas as pastures with fence control.

"When the animals are in riparian areas, they are there strictly to benefit those areas," commented Cranney. "The areas are grazed outside the fences." This results in better grazing in upland areas, and minimal damage to streams and riparian habitat.

Cranney said that sometimes the best wildlife management practice on winter ranges is not the most aesthetic, and visa versa.

"You go to Salt Lake City where cattle have been excluded for decades and it looks good from a watershed standpoint, very little open bare ground, and yet it's poor for big game because there are few browse species," said Cranney. "That's why we concentrate on winter range areas. In most of Utah, the condition of winter range and the amount of it is critical."

Cranney said one strategy his agency uses to protect mule deer winter range is wildlife easements.

Said Cranney, "Wildlife easements leave the property in the hands of the owners and allow them to conduct operations compatible with good wildlife management." He also noted the most important aspect of wildlife easements is that they prevent subdivision of property into small ranchettes.

"Subdividing is the biggest enemy," said Cranney.

Glenn Erickson, Chief of Montana Department of Fish, Wildlife and Parks Wildlife Management Bureau, echoed Cranney's emphasis on keeping large tracts of land in private ownership. "We want to keep large, connected adjacent blocks of land in private ownership if we can."

He said his agency places a strong emphasis on working with private landowners to improve livestock grazing practices.

"We're providing consultation to landowners whenever they request it," said Erickson. "We have a couple of people assigned full time to deal with grazing systems, and we have a couple of consultants that we work with through Montana State University. So there's a big resource of information we provide."

Erickson said his agency uses livestock grazing to improve the vegetation and soil on the state's wildlife management areas.

"We modify how livestock graze, and where they graze," said Erickson. "We typically try to protect riparian zones and manage vegetation zones in the pastures. It's a rest rotation system, and the purpose is to benefit the vegetation for all species."

Erickson commented that working with private landowners can multiply benefits to wildlife. "In some cases, we have our management area tied to adjacent private land, and we're able to expand the advantage using a cooperative agreement," said Erickson. "The landowner benefits and we benefit."

Western wildlife agencies and provinces will continue to place an emphasis on positive working relationships with landowners and livestock managers to create mutually beneficial programs that ultimately enhance wildlife habitat for mule deer and other species. In doing so, land managers can assure that proper livestock management will continue to be a strong, positive change agent for mule deer habitat.

Grazing by livestock is a common and sometimes competing land use on many mule deer ranges. By Lee Carpenter

The Mounting Pressure of Development

Oil-Gas-Mineral Exploration and Mining

You've read the bumper stickers - "Wyoming - Like no Place on Earth." And "Wyoming Wildlife - Worth the Watching." The scenery and solitude of the wildness of Wyoming is special in the hearts of residents and nonresidents alike.

Add 100,000 wellheads to a landscape that is already feeling the effects of other kinds of energy developments, and "Wyoming - Like no Place on Earth," may take on a new meaning significantly different from the one bumper sticker creators had in mind. The Powder River Basin Oil and Gas Project could be the catalyst for that change in meaning.

The project is a proposed coalbed methane development that would encompass over 7 million acres in northeastern Wyoming. Coalbed methane is a form of natural gas generated in coal seams. There has always been an interest in extracting this resource from the land, but technology prevented it from happening. Recent advances in technology are forcing Wyoming to brace for unprecedented coalbed methane production, with an estimated 50,000 to 100,000 wells drilled in the next several decades.

Development can sometimes create wildlife habitat, and in the case of this project, some aboveground improvements such as watering sites for wildlife seem possible.

But there are serious concerns, as well. Biologists believe that mule deer and their habitats can be harmed because of oil, gas and mineral exploration and extraction. An increase in mortality, ingestion of toxins, loss of habitat, barriers to migratory mule deer that move from winter to summer ranges, and disturbance that fragments and degrades habitats have the potential to affect mule deer populations.

Wyoming Game and Fish Biologist Steve Kilpatrick said oil and gas exploration in mule deer winter range may have negative indirect effects, as well as direct effects.

Oil development southwest of Big Piney is western Wyoming mule deer winter range. By Dan Stroud.

"The direct effects are roads and disturbance," said Kilpatrick. "Once you have those, you have fragmented the habitat. Big game can't always jump roads. Then you set yourself up for successful fire suppression operations where you can intercept fires. We can more easily control and master natural processes with roads. And we can't go into these places to do prescribed burns because of the risk. We're now limited with going in there and doing mechanical things to mimic fire, but these techniques aren't as effective because of reductions in nutrient recycling."

And there are other issues, as well. Ground water has to be removed to extract methane from coal seams. If this water is contaminated, where will it be placed? If it isn't contaminated, where will it be used? If additional water is placed above ground, it could effect a positive change by creating new wetlands. Or, it could change stream flow and the habitats of native fish.

Coalbed methane projects have the potential to disturb wildlife at critical times of the year. Coalbed methane wellheads are small, but each comes complete with its own road and utility line. No one knows the effect this project would have on sensitive wildlife such as sage grouse, a species of concern throughout the West.

Development has the potential to affect more than native fish and wildlife. Development will attract more people to Wyoming, placing additional stresses on existing resources. Construction of new power plants will place greater demands on water resources.

One of the most significant potential impacts is the visual effect on the landscape of Wyoming. Visions of breathtaking landscapes may be cluttered with the signs of energy exploration.

How do state fish and wildlife agencies respond to these challenges?

Dan Stroud, a habitat biologist with the Wyoming Game and Fish Department in Pinedale, said issues concerning shrub habitats, sensitive species and development are creating a crisis in agencies throughout the West.

"We simply are not able to keep up with the extensive wildlife habitat management needs we face across our vast landscape," said Shroud.

Stroud said efforts must be focused on "larger habitat assessments coupled with management solutions," but that the direct effects of large-scale landscape changes are difficult to quantity.

"We can't quantify the specific effects of coalbed methane development," said Stroud. "We don't know the effects on mule deer from a stress standpoint." As an example, he added that mule deer are living in and around towns that seemingly aren't stressed by people.

But Stroud said wildlife are affected by development.

"The direct effects of development to mule deer are habitat removal combined with the pressures of existing grazing of livestock," said Stroud. "You're reducing the forage base so there's more competition for what's left."

The BLM's Senior Wildlife Specialist Cal McCluskey believes it is important to look at oil, mineral and gas exploration on a large scale that crosses political boundaries.

"Places like Powder River basin and southwestern Wyoming are key areas, not just for Wyoming, but regionally, and nationally, because of the large mule deer winter ranges they provide," said McCluskey.

McCluskey said the BLM is developing a sagebrush biome conservation strategy to help identify key areas within the landscape throughout the sagebrush ecosystem. His agency will use that information to help influence land use allocations.

"Land use allocation is where the rubber meets the road," said McCluskey. "One of the limiting factors on past land use plans is they've been developed with blinders on, ignoring what's going on by looking at the administrative boundary the land covers. To make better decisions that have longer term value for all resources, you have to take a broader look on a larger scale, and ask how it relates to smaller pieces of land. That will help influence decisions."

Regardless of the types of decisions made, diligent, consistent long-term monitoring of mineral, oil and gas exploration sites will be necessary to truly understand the effects of this type of development on the landscape, people, and native fish and wildlife. In the meantime, Wyoming is one of many western states and provinces that has the difficult challenge of grappling with the energy needs of its citizens and nation, with the impressive landscapes that make "Wyoming – Like no Place on Earth."

3

A Place for Predators

When farmers and ranchers began settling the American West, they arrived with livestock to graze, seeds to plant and a mentality to tame the West. They perceived the greatest threat to their livestock and crops was predators. Predator management, labeled "one of the most controversial issues involving North American wildlife" by James Trefethen a quarter of a century ago in his book, "An American Crusade for Wildlife," continues to be highly controversial today. And there are few signs this controversy is going to lessen.

Six animals are identified as mule deer predators – gray wolf, mountain lion, bobcat, coyote, black bear and grizzly bear. The first three on the list have to kill prey species to survive. Coyotes and bears have a varied diet that includes plants, thus they can and do kill prey, but do not have to do so to survive.

Predators are controversial for three primary reasons:

- *Different segments of society place different values on predators.*

- *Agencies responsible for management of predators are caught between a rock and a hard spot because of the differing values the public places on predators.*

- *Depending on a variety of factors, reducing predators may or may not help increase numbers of mule deer in a given area.*

Societal Values

Many segments of society place differing values on predators, with ranchers and animal rights activists on opposite sides of the spectrum. Ranchers and farmers don't appreciate a mountain lion, wolf or coyote in or around livestock pastures because predators are seen as a potential loss of personal property and income.

Animal rights organizations and others place a value on predators as charismatic megafauna, large wildlife species that embody the symbol of wilderness.

And biologists have individual views regarding predators because of personal experiences, and published scientific information that is conflicting in its conclusions about the roles predators play in the management of prey populations.

To understand how the values of these three groups come into play and affect the ability of state agencies and provinces to manage predators requires a short course in the population dynamics of mule deer.

The Numbers Game

Mule deer populations increase when more deer are born than die, and decrease when more deer die than are born. Most mortality in deer herds occurs in young deer immediately after birth, or during mid- to late winter. Carrying capacity, or the ability of the habitat to support the herd, helps determine the size of the herd. Carrying capacity is estimated based on the body condition of mule deer and the amount of vegetation that is browsed by deer.

Additive and compensatory are the two types of mortality that occur in mule deer populations. An increase in one cause of mortality or the introduction of a new type of mortality may or may not increase the total number of animals that die, depending on whether that mortality is additive or compensatory. If the increase or introduction of mortality increases the number of deer that die, the mortality is additive. If it is compensated for by reductions in other types of mortality, and therefore doesn't change the total number of deer that die, then it is compensatory.

It is believed that when a mule deer population is at carrying capacity (the ability of the capacity of the habitat to support it), mortality is compensatory. Mortality becomes more additive and less compensatory as the population falls further below the carrying capacity of the habitat.

A mule deer herd that is at or above the carrying capacity of its habitat may produce fewer fawns than one that is below carrying capacity, and mortality will be high so that the population remains stable.

A herd that exceeds the ability of the habitat to support it will be in poor body condition, and have poor birth rates and high death rates. If the population continues to remain above carrying capacity, it will damage its food resources, so that even when the herd does recover, carrying capacity may be reduced and the herd may be unable to return to previous population numbers.

Predation and carrying capacity of the habitat are linked. When a deer herd is at carrying capacity, the number of deaths equals the number of offspring that survive to age one. In this herd, it is not important if predators cause some mortality, because if the predators are removed, another factor will cause a similar amount of mortality. In other words, mortality is compensatory.

The further below carrying capacity the herd becomes, the more additive mortality plays a role in reducing the number of mule deer. The problem is that it is extremely difficult for biologists to pinpoint which mortality factors are playing the greatest role in a mule deer herd on the sliding scale of additive and compensatory mortality.

Grizzly Bear. By Wyoming Game and Fish Department.

Some biologists believe mortality is density dependent. For example, if one type of mortality is reduced in a deer herd that is nearing capacity, another type of mortality will replace it. In a herd that has severe winter as its only major mortality factor, hunting does before winter would not hurt the population. Fewer does will likely die during the severe winter to compensate for those that were harvested. On the other hand, if the doe hunting occurs before a mild winter, the mortality could be considered additive.

What does all of this have to do with predation? That all depends.

Long-term drought can reduce the ability of a habitat to support mule deer, causing significant declines in some populations. Drought reduces the quality of the habitat and can affect the body condition of deer, potentially making them more vulnerable to predation.

If predators contribute to significant mortality in a mule deer population, and that population is near carrying capacity, removing predators may not cause the population to increase because other types of mortality may kick in and compensate for predation. On the other hand, if predation is causing a mule deer population to exist below the ability of the habitat to support them, reducing predators may allow the

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mule deer herd to increase until compensatory factors kick in. The true question is not whether predation affects mule deer, but how much.

Research Results

The few predation studies that have been conducted on mule and black-tailed deer have been somewhat limited in their ability to draw conclusions across mule deer populations. But biologists have been able to glean some useful information:

- *Weather affects the impact predation may have on mule deer by changing deer forage and cover, the densities of prey species and the physical condition of deer.*
- *Wolves can effectively reduce deer populations, particularly on island habitats, and especially if they are the primary predator.*
- *In some undisturbed arctic environments, severe weather or human over-harvest can cause a mule deer population to decline. Predation can further reduce that population or prevent it from recovering. However, most of the environments where mule deer exist today have been altered by fire suppression, development, fragmentation of habitat and other factors. In these habitats (most of the West), biologists believe predation does not cause declines in deer populations. The effect predators have on prey populations in these environments is more complex and related to how humans affect predators, prey and habitat, and the types and densities of predators that exist.*
- *The effects of predators are complicated because there is more than one species of predator – wolves have to kill and eat prey species to survive, while coyotes can survive on plants. If mule deer and large mammal populations decrease, coyotes are less susceptible to these prey reductions because of their ability to eat a variety of foods.*
- *To warrant a reduction in predators, predation should be identified as an important mortality factor, and managers must estimate the population of deer relative to the carrying capacity of its habitat.*

What does all of this mean? Despite everything we've learned about predators in the past century, they are as "good or bad" as they were 100 years ago.

Jim deVos of the Arizona Game and Fish Department said, "In cases where you can't demonstrate that predation is, in fact, a population regulator, predator control is nonsensical. When you can demonstrate predators are having an effect, predator control can be effective."

The effects predators have on prey populations are dependent upon habitat conditions, the numbers of predators and prey, and the sex and age ratios of predator and prey populations. Sorting through these factors makes it very difficult to determine the effects of predation on mule deer and elk populations because every mule deer population is different, and other factors that affect a mule deer population will determine the extent of the effect of predators.

Widespread predator management may or may not increase a mule deer population. Smaller mule deer populations may be more susceptible to predators than larger ones. Larger populations can afford more losses to predation than smaller ones. If a mule deer population experiences one or more severe winters or droughts and their numbers are low, they may be more susceptible to predators until their population numbers increase.

"In cases where you can't demonstrate that predation is, in fact, a population regulator, predator control is nonsensical. When you can demonstrate predators are having an effect, predator control can be effective."

In years when mule deer populations are lean, some predators such as mountain lions and wolves may consume several wildlife species including elk and small mammals, causing the predators to maintain artificially high numbers. While this has the potential to slow the growth of mule deer populations, scientific studies show that reducing predators does not increase the number of fawns that survive to adulthood. And it's the number of fawns that survive to adulthood that determines the growth rate of a mule deer population.

The wolf is one of several mule deer predators. By George Andrejko.

If there are big changes to habitat that result in different movement patterns for mule deer, they could become more susceptible to predation. Changes in habitat may also change predator communities. In the last century, there has been a shift in the predator community from wolves to coyotes. Human-induced factors have contributed to loss and change of wolf prey and wolf habitat, causing the elimination of wolves in many parts of the United States.

Recommendations for Predator Management

Many of the human influences that have caused changes to how predators and prey interact make managing healthy populations of both difficult and challenging. Some segments of the public want effective predator management programs so that their livestock and wildlife are protected, while others place a value on the presence of predators in wildlands. As this debate continues, mule deer populations have been declining.

Increasing concern with declines in mule deer and black-tailed deer populations in large parts of the western United States prompted several wildlife professionals to review wildlife research and make recommendations on future research and management of predators.

Wildlife professionals determined that reducing the number of predators in an area may help deer populations if:

- *Predator management occurs when the deer population is lower than the ability of the habitat to support it.*
- *Predation is identified as a factor that is limiting the ability of the deer population to grow.*
- *The predator population is reduced enough to yield results.*
- *Reduction in predators occurs just before reproduction of predators or prey.*
- *Reduction in predators occurs on a scale of less than 250 square miles.*

They also determined that predator management did not successfully improve mule deer populations when:

- *Mule deer populations were at or near habitat carrying capacity.*
- *Predation was not a key factor limiting the ability of the deer population to grow.*
- *Reduction of predators did not reduce predator populations to a significant degree.*
- *Reduction of predators occurs on large-scale areas.*

Wildlife professionals recommend a wildlife management plan be completed before reducing predator numbers. That plan should include the status of mule deer populations and the population objective desired from a reduction in predators, desired removal goals for the predator species, timing, method and scale of removal efforts, and a description of other factors that may be depressing mule deer populations. The plan should also include monitoring and evaluation of predator and prey populations, and the thresholds when reduction of predators will cease or be modified.

Professionals also recommend long-term studies on coyote, mountain lion and black bear, and human dimensions work to better understand public acceptance of predator management, and a cost-benefit analysis of predator control.

The debate about the good and bad of predators will likely not be resolved in the near future as habitats continue to be fragmented and susceptible to human influences, and the public continues to align itself with one or more "stances" on predators.

4

Precipitation- a driving force

It doesn't seem possible that raindrops or snowflakes would affect the ability of mule deer to thrive. But in fact, precipitation is a key factor that drives mule deer populations.

The amount and timing of precipitation affects plant growth and quality, deer diet and nutrition, the ability of a habitat to support a population of deer, distribution and movement of deer, predation and management. Also, extreme weather such as droughts, prolonged periods of extreme cold or excessive snow can directly cause mule deer mortality.

Plant growth and quality

Precipitation affects soil moisture, ambient temperatures and annual plant growing seasons, all of which affect the plants that mule deer eat on winter and summer ranges. In desert environments, precipitation is critical for new spring growth. In northern climates, severe winters with large amounts of snowfall may increase mortality because deer do not have access to food.

Habitat and Deer Nutrition

Mule deer eat browse tips, forbs and grasses, although their diet is primarily shrubs. How much of each kind of food a mule deer eats is directly related to the availability of it in the environment. During years of normal rainfall, deer may feed primarily on nutrient-rich deciduous shrubs. In years of drought, they may eat mostly evergreen and drought-resistant plants.

Extremes in precipitation can directly affect the ability of mule deer to eat nutritious foods. For example, deep snow can reduce availability of forage in northern climates, while drought can lessen availability of forbs and grasses in desert environments.

Inadequate precipitation reduces the availability, annual growth, digestibility and quality of important plants, and forces deer to eat more food with less nutritional value. Each of these affects energy levels and the overall ability of a habitat to support a mule deer population.

If winter and spring precipitation are low and there is little new growth of plants, deer are forced to eat older plants that have less nutritional value and are more difficult to digest. Poor forage can delay the age at which deer become sexually mature. Poor nutrition makes it difficult for does to successfully rear fawns because of the inability to provide adequate milk during lactation. Even if fawns survive, their small size may make them more susceptible to predation, or the rigors of winter.

Severe winters with significant snowfall and cold temperatures may lead to malnutrition of deer, resulting in fewer fawns produced, and a higher than average death of fawns and adults.

Drought is a long-term, natural, cyclic event that is linked to declines in mule deer populations, particularly in arid regions. Both seasonal and long-term droughts can affect the survival of deer fawns. In general, higher levels of rainfall correlate to improved production, whereas lower levels of rainfall have been associated with declines in production and numbers of mule deer.

Distribution and Movement of Deer

Precipitation influences the distribution and movements of mule deer in northern, cooler climates and drier, desert climates. Home ranges of mule deer increase with a decrease in quality habitat because the animals need to range farther to meet their nutritional needs.

Group of mule deer bedded in deep snow in Colorado. By Len Carpenter.

During severe winters with deep snowfall, deer may be crowded on small winter ranges, unable to travel through deep snow to meet their nutritional needs. Providing good cover to help deer conserve energy is critical during severe winters.

In desert environments, plant density and rainfall seem to be good predictors of distribution and productivity.

In mountainous regions, seasonal migrations are based on availability of food resources. Snowstorms cause deer to migrate in fall, while migrations from winter to summer ranges occur with lush, spring growth and receding snowlines. In mountainous regions with less severe climates, migration may be closely associated with changes in relative humidity.

Predation

Interactions between predators and prey are related to the ability of a habitat to support a population of deer, weather, human use patterns, the type of predator and changes in habitat. For example, during drought periods in Texas, mule deer numbers are below carrying capacity, and predation by mountain lions may be significant.

Disease

Little scientific research exists to suggest there is a direct relationship between spread of disease in deer and precipitation. Deer may concentrate around water during dry, hot summers, however it is more likely that drought causes poor nutrition in deer, leading to greater susceptibility to disease.

Pollution

Acid precipitation can damage foliage and roots of vegetation and destroy soil nutrients and organisms, resulting in greater susceptibility to disease, drought, and frost, and reduced germination and seedling survival. Acid precipitation may also lower trace minerals in forage, an important component in the diet of ungulates.

Management

Deer populations may be managed with greater accuracy by making correlations between climate and survival of deer fawns. Mean snow depth, ambient temperatures, wind speed, drought severity index and several other climatic factors can help managers predict fawn survival, particularly in extreme desert scrub and montane conifer environments.

5

Wilderness Breakup

The American West is growing and changing, and nothing indicates there is going to be any slowing to the development and sprawl into what was once considered "natural landscapes." How people and wildlife fare as they attempt to coexist will determine whether or not people place a value on large tracts of open space.

In 2000, Bill Riebsame of the Department of Geography at the University of Colorado-Boulder, presented a paper titled, "Life in the New West: Human and Wild," at the Western Association of Fish and Wildlife Agencies conference in Redmond, Oregon. During that presentation, Riebsame said the American West was "experiencing rapid demographic, economic, and cultural change," and was growing faster than any other region in the United States. Most of the growth is occurring in what he called "exburbs," or non-metropolitan areas next to cities. Exburbs are characterized as having one house per 10 to 40 acres, and it is these areas that will likely have the most effect on wildlife management in the future.

The Center for the American West has a web site called Western Futures at www.centerwest.org. The purpose of the site is to describe projected growth in the American West. From 1960 to 2050, exburbs are projected to grow from about 10.5 million to 40.8 million. The human population in the West is expected to grow from 61.3 million in 2000 to 109 million by 2050. Every state is expected to show an increase in urban, suburban and exburb areas, and a loss of rural areas as 2050 approaches.

Land developers can make well-intentioned attempts to incorporate natural escape cover near areas where mule deer can find adequate food. But overall, attempting to create habitat for mule deer in and around urban areas is a bad deal for both people and deer. Why?

- *Large numbers of deer in urban areas creates havoc with local landowners who don't appreciate mule deer eating their expensive yard shrubs.*
- *More deer in and around urban areas results in more vehicle/deer collisions.*
- *Urbanization may change movements of mule deer, causing deer that were once migratory to become yearlong residents.*
- *When wildlife become concentrated in an area, there is greater possibility for spread of disease.*

What can be done to discourage the presence of mule deer in developed areas?

- *Human transportation corridors such as highways, railways and canals pose threats to both people and game mammals, especially when those corridors cross a traditional migration path. To minimize interactions with mule deer, vegetation along transportation right-of-ways should be planted with species that are undesirable to wildlife.*
- *Construction that disrupts wildlife migration paths should be avoided.*
- *Passage structures along transportation corridors should be designed to minimize wildlife loss.*
- *Creating wildlife habitat in urban interfaces should be avoided. Instead, set aside good wildlife habitat in areas removed from urban sprawl to keep wildlife away from human populations.*

Interstate 70 in Vail, Colorado. The highway greatly impairs the movement of deer between summer and winter range in spite of efforts to maintain seasonal movements by building an underpass specifically for deer. By John H. Ellenberger.

Selling off critical deer winter range in Utah's Uiata Basin. By Steve Crooney.

As the human population continues to grow, more pressure will be placed on wildlife forced to adapt to the effects of urbanization and habitat fragmentation. Fragmentation of land from development of all kinds, whether it be homes, ranchettes or gas and oil wells, poses one of the greatest challenges to land managers who must balance the needs and wants of a citizenry that values open spaces and wildlands, yet whose very presence compromises that goal.

The pace of development and human immigration into western states and provinces has caused of rapid loss of mule deer habitat. In a six-year period from 1992 to 1997, 16 million acres in the United States were developed. A large percentage of those acres were in places occupied by mule deer.

6

Elk & Mule Deer Interactions

Competition is defined as a rivalry or a battle of wills and opposing sides, and brings to mind the classic image of sports teams going head to head on the gridiron. But competition between species in the animal world takes on a different meaning, especially when the subjects in question are mule deer and elk.

Competition occurs when two species use the same limited resource, and one of the two suffers in some way because of that use. But for true competition to take place, the suffering must occur at the population level, where one of the two species has lower survival rates or fewer young that survive to adulthood. Merely viewing mule deer and elk in the same valley foraging on similar plants is not true species competition.

Given the definition of competition in wildlife, do elk, whose numbers have been increasing in the West over the past several decades, compete with mule deer, and if so, in what way does that competition affect mule deer populations? Looking at adaptations mule deer and elk have developed over time can provide clues that may help answer the question.

1. Energy - Summer heat and severe winter conditions place the greatest stress on mule deer and elk. Mule deer movements and foraging become restricted in snow depths of 10 inches or more, whereas elk are not adversely affected until snow depths reach 18 inches. If mule deer and elk are using the same resources in severe weather, elk will have the advantage.

2. Digestion - Mule deer have smaller stomachs than elk and forage on shrubs and forbs, compared to the grass-dominated diet of elk. Mule deer need better quality plants with greater digestibility than elk. If resources are restricted because of habitat or weather, elk would have the survival advantage.

3. Changes in habitat – Landscape changes across the west have created habitats that may be better suited for elk than mule deer.

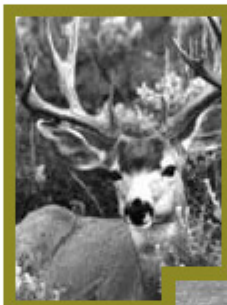
4. Livestock - In some cases, deer and elk may completely leave an area that is heavily grazed by cattle. Competition between mule deer and elk may increase if these species are forced to move from preferred habitats to less suitable habitat types.

5. The Human Factor - Development in winter range affects mule deer more than elk because elk are capable of wintering in higher elevations than mule deer. Elk hunting seasons can cause elk to move into dense cover and forage in areas used by deer.

6. Parasites - Biting flies affect elk more than mule deer, and horseflies carry a disease called elaeophorosis, an arterial worm that causes blindness, malformed antlers, loss of muzzle and ear tissue, and death in elk. Mule deer are unaffected by the disease, but are hosts for the worm.

7. Predation - The effects predators such as mountain lions, black bears, coyotes, grizzly bears and wolves have on prey populations are dependent upon habitat conditions, the numbers of predators and prey, and the sex and age ratios of predator and prey populations.

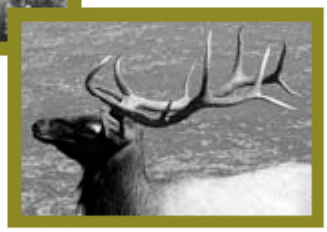
8. Population Dynamics - Elk are longer lived, produce fewer young during their life, and are found in fairly stable habitats. Mule deer have shorter lives, produce more young during their life, and live in unstable habitats, or habitats that change over time.



Tom Keegan, Wildlife Manager with the Idaho Department of Fish and Game, said that making a statement that elk are responsible for mule deer declines would not be accurate because some mule deer populations have declined in the absence of elk. And Keegan said, "Other deer populations have grown and responded well in conjunction with growing elk herds.

"The problem I see is half the people wanting more elk and half the people wanting more deer," said Keegan. "One piece of land won't fit their expectations. And what people want quickly changes all the time. At some point, state agency managers are going to get stuck between a rock and a hard place every time they go down a management road."

Fred Lindzey, Assistant Wildlife Cooperative Unit Leader and Professor at University of Wyoming, said habitat and weather are driving forces for mule deer.



"A lot of livestock management practices create grasses that benefit elk more than mule deer," said Lindzey. "Elk can physiologically handle more roughage. So you end up with competition for the food resources. Habitat manipulations that we have brought about have largely favored elk over mule deer."

Lindzey said weather increases the potential for competition between mule deer and elk. "There were very few historic records where we lost large numbers of elk to bad weather," he said. "At the same time, we really lost a lot of mule deer during the severe weather of the 80s. Mule deer are extremely sensitive to severe weather patterns. The mule deer population is being knocked back in local areas, and elk are increasing, and weather has exacerbated the situation."

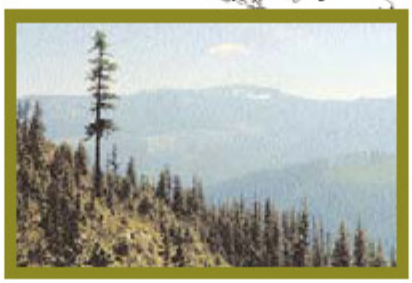
Lindzey said interactions between mule deer and elk generally don't occur long-term. "I think these interactions occur periodically," said Lindzey. "You've got mule deer on that human-agriculture edge with the elk above them and people below them, and they can no longer drift further down into these valleys - it's the old winter range problem. Elk are separated from mule deer by vegetation, but in a bad year, they fall down on top of the mule deer. Elk can physically displace mule deer or keep them from using the resources. This may happen one year out of six." But that one bad year can hurt a mule deer population, especially when winter range and transition ranges are being lost to development.

"Mule deer are driven by environmental factors," said Lindzey. "We've lost critical and valuable mule deer winter range. Most of these winter ranges just sustained mule deer through the winter. They don't get fat on winter ranges – they just expect to break even. If you shorten those opportunities where they can move to secure the greatest reduction in energy – and that's what is happening with all this oil and gas development - then in a bad winter, you lose the fawns. If you can't access those resources to mediate the effects of weather, then you have adult survival problems. These guys are engineered to handle the weather that is dumped on them. But now we've started to muck up the good stuff."

Lindzey stressed the importance of long-term research to give biologists the tools they need to make management decisions, respond to development issues and answer questions about mule deer and elk interactions.

"If there's anything biologists are lacking as a group, it's long-term research that elucidates the influence of potential impacts on populations. Without those data, we'll always be sticking our thumbs in the dike."

ECORE



Coastal Rain Forest

California Woodland
Chaparral

Intermountain West

CGIONS

Northern Boreal Forest

Great Plains

Colorado Plateau

Southwest Deserts

Mule Deer Regions- No Two are Alike

No two mule deer populations are alike because where they live differs from one part of their range to another. Biologists refer to the different areas as "ecoregions". By studying each ecoregion, biologists can better identify the factors that are limiting the growth of mule deer populations, and predict responses by mule deer populations to changes in habitat. Habitat quality has an effect on survival of fawns, the most important factor in determining how well a population fares from season to season, and year to year.

Biologists have identified seven ecoregions that mule deer call home. Each ecoregion is briefly summarized including a physical description, a description of the deer, the climate, limiting factors that reduce the productivity of deer, and recommendations to improve mule deer populations.

All ecoregions are subject to the limiting factors such as urbanization, fire suppression and drought described in this publication. The limiting factors listed for each ecoregion in this article are some of the most important, but certainly not the only factors, limiting mule deer populations.

Although each region is ecologically different, some common factors exist:

- *Generally, habitats conditions that are less productive for mule deer.*
- *Human caused factor such as fragmentation of habitat, changes in fire regimes, livestock management and changes in plant communities have limited deer populations.*
- *Return to higher mule deer numbers will require stronger land use planning and restoration efforts on a large scale.*
- *Climate and weather play an important role in habitat quality in each region.*

Mixed conifer habitat of Coastal Rainforest Ecoregion, west slope of Cascade Range, Douglas County, Oregon. By Tom Keegan.

Coastal Rain Forest Ecoregion

Description: Along the west coast of North America from northern California through southeast Alaska. Known for its dense rain forests of western hemlock, Sitka spruce and natural and commercial forests of Douglas fir. Clearcutting is common in commercial forests, and provides excellent habitat for mule deer for eight to 10 years after harvest when grass, forbs, shrubs and saplings are common. In the northern part of this region where winter snowfall can be heavy, it is important to retain stands of mature trees to intercept the snow.

Climate: A marine climate with cloudy days, cool temperatures, high precipitation from fall to spring, and a short, dry summer season. Precipitation ranges from 25 to 120 inches. Soils are coarse and nitrogen-poor.

The deer: Black-tailed deer are the dominant subspecies of mule deer. The deer are primarily non-migratory, and are well distributed and occur at the greatest densities in early successional habitats in the central and southern part of the region. In the northern part of this ecoregion, deer numbers are greatest on coastal islands, where marine weather lessens the severity of winter. In the far north, winter snow may force deer to lower elevations.

Black-tailed deer are often unable to meet their nutritional requirements year round. Fawns rarely breed, and pregnancy rates for yearlings vary greatly from year to year, but are generally low.

Deer in this region tend to be older than in other regions because the amount of secure cover deer find in the dense forest limits hunter success.

Limiting Factor: The quality of the plants. Heavy rainfall and soils poor in nitrogen cause nutrients to leach from the soil, and plants have more moisture. Pound for pound, a deer consumes less nutrients while foraging in coastal rain forest than in other regions.

Recommendations:

1. *Create more grass, forb, shrub and sapling communities to improve food quality.*
2. *Maintain forest canopies in places where snowfall is heavy.*
3. *Manage forests for high quality plant foods to allow for large harvest of deer to reduce overwintering populations, and thus reduce browsing on young conifers.*
4. *Survey for diseases and parasites.*
5. *Plant mast producing species such as oak in dry and southern areas.*
6. *Conduct small, cool controlled burns.*

Live oak-chaparral woodland habitat shot taken of Bloomfield Ranch, Kern County, California. By Marc Hoshovksy.

California Woodland Chaparral

Description: Includes the Coast Range of southern California, and lower elevations of the west slope of the Sierra Nevada east into central Arizona.

Climate: Hot dry summers, mild wet winters, and periodic droughts create annual grasses and forbs in communities of oak woodland and chaparral. Precipitation ranges from 8 to 30 inches a year. Chaparral was once maintained by frequent, cool fires, but fire suppression created older stands of chaparral with poor quality forage.

The deer: Mule deer populations in this region do not migrate, except for those at higher elevations in the Sierra Nevada and San Gorgonio Mountains. Deer densities are greatest in the northern part of this ecoregion. Nonmigratory deer move in response to changes in habitat on north and south facing slopes.

Limiting factors: Fire. Most of the mule deer range in this region is in private ownership, and fire suppression is a high priority for residents. This region is in a fire-adapted habitat, and frequent fires occurred before European settlement. Frequent fires rejuvenate the habitat and improve forage for mule deer. Fire suppression results in infrequent, large, hot fires. The lack of fire results in older, less nutritious plants for mule deer.

Weather. Summer and early fall is a difficult time for mule deer because of little rainfall, and dry plants with little nutritional value. Nursing does need high quality forage to nurse fawns and build body reserves for the coming winter.

Recommendations:

1. Use fire to stimulate sprouts of shrubs over a large landscape.

2. Stimulate new growth of desired plants using light livestock grazing.

3. Minimize effects of livestock along streams and uplands to improve forage for mule deer on fall and winter ranges.

Southwest Deserts Ecoregion

Description: Includes the southern portions of California, Arizona, New Mexico and west Texas, extending into northern Mexico.

Climate: This region is arid to semi-arid, and has extreme temperatures, high evaporation rates, low rainfall that varies greatly from year to year, periodic droughts and poor soils. Precipitation ranges from 5 to 20 inches annually.

The deer: Deer are nonmigratory and greatly affected by droughts. Fawn recruitment is variable depending on amount and timing of rainfall. During dry years, fawn recruitment is typically below what is needed to maintain the population.

Limiting factors: Rainfall and competition with livestock. Winter rainfall affects the diversity, quality and quantity of next years' spring forbs, which directly affects the number of young deer that are born and survive to adulthood. Winter precipitation stimulates plant growth in the spring. Forbs are critical to the survival of deer in this ecoregion because browse plants don't contain adequate amounts of nutrients.

Competition with other forb and grass-eating species such as livestock can have a great effect on mule deer, especially during years when rainfall is limited and range resources are scarce. Overgrazing in drought years can have long-lasting effects.

Recommendations:

1. Create sources of water in areas where water is limiting and where other potentially limiting factors are being addressed.

2. Monitor grazing so that livestock do not remove large amount of plants, particularly in years where drought or other climatic conditions stress deer.

3. Work with landowners to provide hunter access to public land.

4. Monitor human sprawl.

Spring wildflowers in the Southwest Deserts ecoregion. By Arizona Game and Fish Department.

Regions

Mule deer habitat used in the Great Plains ecoregion, Scotts Bluff National Monument in western Nebraska. By Mike Cox.

Regions

Great Plains Ecoregion

Description: The largest grassland ecosystem in North America, extending from central Canada to the Texas panhandle, west to the Rocky Mountains. The region includes a transition from tallgrass to shortgrass prairie.

Climate: This region is semi-arid, annual precipitation varies between 10 and 33 inches, and temperature varies greatly.

The deer: Mule deer in this region are nonmigratory, although they shift their home range in response to local moisture conditions that affect plant quality. Mule deer forage on agricultural plantings in areas that are irrigated.

Limiting factor: Cover. Drought and severe winter snows can affect mule deer populations. Fire is important in maintaining grasslands.

Draws that contain shrubs, hardwoods and moisture provide mule deer with critical habitat, especially in the winter. Grassland and shrub/grassland communities interspersed with draws provide critical year-round habitat for mule deer. Irrigated fields grow nutritious grasses for mule deer forage.

Human activities are a double-edged sword for mule deer. While agriculture provides watering holes and alternative food sources for mule deer, overgrazing by livestock is harmful to the woody draws that provide cover and moisture.

Recommendations:

1. *Work with landowners to minimize the effects of severe weather conditions by providing hard woody cover for mule deer by improving grazing strategies and riparian habitats.*
2. *Provide hunting opportunities consistent with habitat conditions and deer populations.*

Colorado Plateau Shrubland and Forest Ecoregion

Description: High elevation areas in western Colorado, eastern Utah, southern Wyoming, and northern Arizona and New Mexico. Habitat ranges from spruce trees at high elevations, ponderosa pine and Douglas fir at mid-elevations, and sagebrush and pinyon-juniper at lower elevations.

Climate: Much of this region is above 5,000 feet and includes many mountain peaks above 15,000 feet. Precipitation ranges from 8 to 24 inches. Winters can be severe.

The deer: Deer are migratory because of the heavy winter snowfalls at high elevations. Deer populations are most affected by severe winters that cause nutritional stress, high fawn mortality and lower fawn recruitment. Some lower elevation ranges can be summer range limited. Livestock grazing may affect the quality of forage available to deer.

Limiting factors: Severe winters and droughts can impact the productivity of mule deer by causing high fawn mortality.

Improper livestock grazing has caused changes in mule deer winter range.

Recommendations:

1. *Limit disturbance to existing winter range, and acquire additional winter range.*
2. *Improve quality and quantity of winter range habitat.*
3. *Maintain stands of aspen for mule deer fawns and summer range.*
4. *Limit development of and disturbance to summer range in areas where summer range is limiting.*

Aspen stand in poor condition because there is no aspen generation and the stand is being invaded by conifers. Fire is needed to restore and rejuvenate this stand. By Dan Stroud.

Steens Mountain, Oregon in the Intermountain Ecoregion. By Tom Keegan.

Intermountain West Ecoregion

Description: The mountain ranges west of the Rockies, east of the Sierra Nevada, north of Colorado and south of Canada. The Great Basin, a large semiarid basin, makes up a big part of this land mass. Pinyon-juniper woodlands, conifer forests and aspen woodlands are common at higher elevations.

Climate: Lower elevation communities receive less than 12 inches of precipitation a year. Areas to the north and at higher elevations receive most of their precipitation as snow.

The deer: If you could draw a bull's-eye around the portion of the West that was once the center of mule deer distribution, you would draw it around this region. Mule deer typically migrate in this region (although some do not), spending summer in conifer forests at higher elevations and winter in lower elevations. Deer densities are highest in places where vegetation and topography are diverse.

Agriculture and urban development have hurt mule deer populations in this region by destroying shrub communities and reducing winter range.

Limiting factors: Competition with livestock, agriculture, urban development and timber management. Each year, thousands of acres of sagebrush habitat and valleys are being overtaken by pinyon-juniper stands, much to the detriment of mule deer.

In the southern part of the region, invasive plants such as cheatgrass and changes in fire cycles are limiting mule deer productivity.

Habitat in spring and summer affect mule deer productivity more than severe winters because the quality of spring and summer range affects the number of fawns surviving to adulthood. Urban development may affect recruitment because it is occurring in mule deer winter range.

Recommendations:

1. *Manage motorized traffic to benefit mule deer.*
2. *Manage forests for both early and late successional stages to meet year-round needs of mule deer.*
3. *Protect and plant important browse species for mule deer, especially in winter ranges.*
4. *Manage wildfires on mule deer ranges to avoid cheatgrass invasion.*
5. *Manage livestock grazing to minimize impacts to mule deer along streams and in aspen habitats.*
6. *Develop cost-effective ways to reduce pinyon-juniper invasion, and place a priority on developing a patchwork of habitats so that mule deer have woody cover near places to forage.*

Northern Boreal Forest

Description: The higher elevations of the Cascades and Sierra Nevadas in the three most western states, as well as northern Idaho, western Montana and Wyoming, northern Washington, and the western Canadian provinces.

Pine, spruce, fir, Douglas fir and larch are the dominant forest types, and forests become more thin as elevation increases. Mule deer are not found very far north of the northern boreal forest in subarctic woodlands.

Climate: Winters are long and cold. Average annual precipitation varies with elevation and topography, from 10 inches to as much as 120 inches.

The deer: Because of severe winters and heavy snowfall, most of the deer in this region are migratory, although some are year-round residents at lower elevations. The growing season is short, and the quality of food mule deer find during this critical time is high. Deer follow retreating snow in search of food.

Limiting factors: Severe winters. Deer follow the growth of plants throughout the growing season. It is only when severe winters and deep snow limit their ability to forage that they experience die-offs and high mortality.

If mule deer populations experience a die-off, there is excellent chance for recovery as a result of spring and summer habitat conditions.

The greatest threats to deer in this region are development and disturbance of winter range, and barriers to migration.

Recommendations:

1. *Acquire winter range habitat and minimize housing developments to protect and enhance winter ranges.*
2. *Use fire to maintain shrub-dominated habitats.*
3. *Maintain forest shrubs, forbs, grasses and saplings to provide foraging habitat in spring, summer and fall.*
4. *Avoid and manage forest encroachment into high elevation meadows.*
5. *Avoid barriers to migration.*
6. *Manage deer populations based on the ability of winter range to support them, and avoid overharvest in years when early winters send migratory deer to lower elevations.*

Male black-tailed deer in mixed conifer forest, Douglas County, Oregon, December 1998. By Tom Keegan.

Plant Communities in Trouble...

Maintaining plant communities and wildlife habitat to meet the expectations of the public and the life requirements of healthy mule deer populations requires more than individual efforts by states and provinces. Policies that cross political boundaries and address factors that contribute to mule deer habitat loss and degradation, and greater emphasis on working with landowners to enhance habitat on private land may be critical to the future of many mule deer herds. The following are a few plant communities in trouble, and one plant community that is thriving to the detriment of healthy mule deer habitats.

Shrub-Steppe

Of all the habitats in the West, the shrub-steppe community has probably fared the worst. Shrub-steppe is the largest natural grassland in North America. It once covered more than 200,000 square miles, and extends from southeastern Washington and eastern Oregon, through Idaho, Nevada, and Utah, and into western Wyoming and Colorado. Shrub refers to the most common type of plant that grows in this habitat, while "steppe" is a Russian word that means a vast treeless plain. Grasses such as wheatgrass and bluegrass, and shrubs such as sagebrush, bitterbrush, rabbitbrush and greasewood are common types of plants found in shrub-steppe communities.
The shrub-steppe region is home to more than 200 kinds of birds, and 30 mammal species, including the mule deer. Mule deer eat sagebrush, particularly during the winter months.

The greatest threats to sagebrush communities are conversion of habitat for agricultural purposes, development, grazing by livestock and fire suppression.

Biologists recommend sagebrush habitats be disturbed using fire or mechanical methods to provide a mosaic of habitats, managing livestock grazing to help vegetation recover, and managing elk and mule deer populations based on the ability of the habitat to support a certain number of ungulates.

And they encourage creativity when reclaiming sites by planting native species that benefit mule deer.

Forests

Forests offer three benefits to mule deer - places to hide, places to lessen the effects of severe weather and places to eat. Quantity, quality and diversity of plants limit the number of mule deer that can exist in a forest.

Forests naturally go through six stages before they become old growth - grass-forb, shrub, shrub-sapling, open sapling-pole, closed sapling-pole-sawtimber, large sawtimber and old growth. Mule deer respond favorably to forests in the first four stages because of the quantity, quality and diversity of plants present soon after logging. The amount of time today's commercial forests offer habitat quality to mule deer is far shorter than in historical times because of how quickly foresters are able to regenerate a forest using herbicides, site preparation and seedling plantings.

Removal of juniper and reestablishment of sage-steppe habitat on slope in southern Oregon. By George Buckner.

The following are some recommendations to improve habitat for mule deer in forests:

- *Maintain portions of forests in early successional stages.*
- *Create markets for pulpwood timber to improve mule deer habitat in forests by thinning pole timber.*
- *Promote the use of fires and reseed with native plants mule deer prefer.*
- *Limit the negative effects of roads. Reseeding roads no longer in use, limiting traffic on roads, closing roads during high stress periods, and estimating the impacts of new roads over a landscape can help mule deer.*
- *Protect hardwood species such as oak to provide mast and cover for mule deer, and protect riparian areas from overuse by deer and other ungulates.*
- *Responsible timber harvest based on adaptive management practices can greatly enhance mule deer populations that use forests.*

Aspen

Aspen is a component of many forest types and covers up to 6.9 million acres in the western United States. It is considered the most widely distributed native tree in North America. Mule deer rely on aspen communities for food, cover, hiding, fawning, fawn rearing, and protection from severe weather, making it a popular habitat type for them three seasons of the year.

Aspen are short-lived, and rarely survive more than 100 years. Fire is important to set back succession in aspen stands to retain grass and forb communities, to set back conifers that outcompete aspen and to create forest openings for aspen. Many aspen stands have not been subjected to fire in over 50 years, creating older aspen stands with few grasses and forbs. A study done in 1981 confirmed the average age of aspen stands in Colorado is 80 years old, and stands younger than 50 years of age were difficult to find.

The distribution of aspen is similar to its historical distribution, but the stands are older, fewer and mixed with conifers.

Biologists recommend stimulating the growth of younger stands of aspen using fire, harvest, mechanical treatments and proper livestock grazing to provide several age classes of aspen stands throughout a mule deer population's range. Fire will also help control coniferous invasion of aspen stands.

Aspen stand with healthy regeneration and understory vegetation in western Wyoming. By Dan Stroud.

Aspen stand in very poor condition due to overgrazing. Note: no young or suckering aspen trees and no understory vegetation. This stand will eventually become too old to replace itself. By Dan Stroud.

Pinyon-juniper

...and One Troubling Plant Community

Juniper invasion into mule deer habitat. Note background with large junipers and understory devoid of shrubs important for mule deer forage. Note sagebrush with shrubs in foreground. By George Buckner.

Pinyon-juniper

Pinyon-juniper plant communities have expanded to over 74 million acres of the Intermountain West. Pinyon-juniper plant communities began expanding when livestock were introduced in the late 1800s, fire was reduced across the landscape and climatic changes occurred.

When pinyon-juniper initially encroaches into shrub steppe communities, habitat for mule deer improves with additional diversity of plants and cover. The improvement is short-lived. Because it is drought tolerant, pinyon-juniper woodlands eventually outcompete forbs, grasses and shrubs, especially in places where woodlands are adjacent to grasslands. Biologists have documented a loss of 80 percent of mountain big sagebrush when juniper covers 50 percent of the canopy of an area. Other plants and plant communities such as antelope bitterbrush, mountain mahogany and aspen are also lost when pinyon-juniper invades an area.

To manage pinyon-juniper woodlands for mule deer habitat, biologists recommend harvesting fuel wood and using fire in grasslands next to pinyon-juniper woodlands to reduce further encroachment and improve quantity and diversity of grasses, forbs and shrubs.

Mule Deer Diseases

You can walk into any center for human disease control in the United States and get as much information as you want on both common and uncommon diseases in people. Wildlife biologists wish the same could be said for wildlife diseases.

While humans have places such as the National Center for Infectious Diseases and the Center for Disease Control and Prevention, biologists aren't as fortunate. Organizations such as The American Association of Wildlife Veterinarians, the National Wildlife Health Center and Wildlife Diseases Association exist to help monitor wildlife diseases. But the weak link in the chain is getting reliable, consistent, quality data to these organizations.

Biologists usually have to rely on large-scale die-offs or individual case studies to track and monitor wildlife diseases. The behavior of wildlife, low numbers of animals observed, lack of training and cost to monitor individuals within a population make studying wildlife diseases even more difficult.

Biologists face other hurdles. Large numbers of observations are required to detect and monitor diseases in wildlife populations. And many of the biologists capturing the wildlife are not trained to collect and handle scientific samples for analysis in a laboratory. Lack of adequate staff and lack of training make it difficult to monitor wildlife diseases.

Cost is another critical factor that prevents biologists from tracking wildlife diseases. Monitoring animals requires capturing, tagging and following those individuals. For longer-lived animals or animals with larger home ranges, these costs are prohibitive for many fish and wildlife organizations.

Difficulties aside, what do we know about disease in mule deer? First, while there are several diseases that affect individual mule deer, only two are known to wreak enough havoc to cause significant die-offs.

The diseases are viral and they cause blood loss. As a result, they are called hemorrhagic (hem-or-agic) diseases - bluetongue (BTV) and epizootic hemorrhagic disease (EHD). Diagnosis of these diseases is difficult because it's tough to tell one disease from the other.

Two other diseases, chronic wasting disease and tuberculosis, are considered emerging diseases.

Hemorrhagic (Bleeding) Diseases

Bleeding diseases were first identified in white-tailed deer populations, where death rates as high as 50 percent were documented. Mule deer fare better with these diseases, usually suffering no more than a 20 percent mortality rate. The diseases are common only in late summer and fall until the first freeze kills the transmitters of the virus, biting midges. Those deer that die usually do so within five to 10 days after being bitten by an infected midge.

When mule deer contract either of the two hemorrhagic diseases, they can show one or more signs of sickness. These include bleeding from the eyes, ears, mouth and/or nostrils, moderate fever, depression, anorexia, excessive drooling, swelling and ulcers in the cheek or tongue (thus the name blue tongue), swelling of one or more of the linings in the stomachs and blood in the feces and saliva.

Chronic Wasting Disease (CWD)

Chronic Wasting Disease (CWD) is so named because it causes chronic weight loss that eventually results in death. It was first documented in captive deer in a wildlife research center in Colorado in 1967.

Since then, it has been diagnosed in captive and free-ranging deer and elk in northeastern Colorado, southeastern Wyoming, Nebraska, South Dakota, Wisconsin and New Mexico and in game-farmed cervids in Colorado, Montana, Nebraska, Oklahoma, South Dakota and Alberta and Saskatchewan, Canada.

Loss of fear of humans, weakness, inability to stand, dehydration, listlessness, repetitive walking in set patterns, dull coat, excessive drooling, drooping head and ears, inability to control muscle movements and emaciation are signs of CWD.

CWD is a transmissible spongiform encephalopathy (TSE), which refers to the fact that in late stages of this disease, the brain becomes full of holes like a sponge. The disease usually takes years to develop, but it can develop in a relatively short period of time.

A mule deer displaying the symptoms of chronic wasting disease. The deer is in poor body condition, appears to be sedated, and is not avoiding human structures or activities. This animal was photographed in northeastern Colorado in the CWD endemic area. By Colorado Division of Wildlife.

Scrapie is the oldest of the TSE diseases, and occurs in sheep and goats. It was first reported in the mid-18th century, but has never been reported in other animals or people. Affected animals lose control of their leg and body muscles that causes them to stagger. Eventually they cannot stand. The name "scrapie" refers to the fact that the animals can become irritable and develop an intense itch that leads the animal to scrape off their wool and break the skin.

Dr. Elizabeth Williams is a professor of Veterinary Science at the University of Wyoming and an expert in the field of wildlife diseases. She said chronic wasting disease is high on the list of priority wildlife diseases to monitor.

"Because of the concern about similar diseases such as scrapie in sheep, CWD is among those diseases the United States Department of Agriculture is interested in eradicating. It will be important in the future," said Williams.

Scientists have not determined what causes chronic wasting disease, but the most accepted theory is that cell proteins called prions (pronounced preeons), change and become disease-causing agents. Many believe the disease is transmitted from animal to animal, like scrapie.

"CWD and the other diseases are similar, but not identical," said Williams. "A lot of the features in scrapie are similar to deer. Clinically, deer don't scratch and itch, but many of the other symptoms are alike."

Increased monitoring by wildlife agencies, increased media attention, stronger public interest in the disease as a result of mad cow disease, and increased numbers of people moving into areas that were once wildlife strongholds likely have resulted in higher detection rates.

Tuberculosis

Another disease of importance to wildlife managers and veterinarians is tuberculosis. Tuberculosis is caused by bacteria, and is spread by direct and indirect contact between animals. Tuberculosis usually affects the lungs, causing difficulty breathing, coughing, and discharge from the mouth or nose.

The United States Animal Health Association (USAHA) is a science-based national forum interested in the eradication of tuberculosis from wild and domestic animals in the United States. It appointed a working group in October of 2000 to develop strategies to address tuberculosis issues.

The first diagnosis of tuberculosis in white-tailed deer occurred in the State of Michigan in 1974. Feeder cattle, dairy cattle and captive cervids, along with wild white-tailed deer and many carnivorous species have been infected.

Williams said tuberculosis has not been found in any deer populations in the West, but that it is a disease of concern because of its ability to spread rapidly.

"Right now, we don't have any evidence of TB in free ranging populations in the West, but we know it's transmitted readily when deer are

concentrated," said Williams. She said it is a disease that needs to be closely monitored because of its potential impact to wildlife and humans.

Jim deVos, Chief of Research with Arizona Game and Fish Department, places a strong emphasis on the importance of increased wildlife research to monitor wildlife diseases.

"I believe it is important that entities with management authority for mule deer make a more serious commitment to disease research," said deVos. "Only when large-scale die-offs occur do diseases become an important issue for wildlife management agencies. By then, it is often too late to do anything other than document the number of mortalities."

DeVos recommends a more aggressive, coordinated approach to wildlife disease research. This includes increased communication between the western states, coordination of veterinarians in western states working on wildlife research projects, creation of a consistent funding base to study mule deer health issues, development of standard sampling protocols so that all mule deer captured for any wildlife research purposes are sampled consistently and using quality standards, and participation in surveillance programs for diseases with high biological or social concerns for mule deer or human health.

If western states and Canadian provinces take this approach to wildlife disease research, there may someday be a place people can go to learn everything they ever wanted to know about wildlife diseases.

Counting the Herds

You can travel all over the world, and any McDonald's restaurant product, whether it's a hamburger or a French fry, will taste the same. McDonald's perfected standardization. Unfortunately, the same cannot be said for the methods to collect information about mule deer.

The first estimate of mule deer populations in the West was probably exaggerated, but that's understandable given the survey methods available at the turn of the 20th century. Biologists weren't flying around in fixed wing aircraft and helicopters counting wildlife, and the ability of one state to communicate about and collaborate on research was primitive at best.

While technology has helped biologists and managers, not every state or province and its funding sources are created equal, making it very difficult for states to survey using the same methods. For example, well funded states may have the staff and financial resources to survey their mule deer populations using helicopters and line transects several times during the year. Other states may have the resources to sample on horseback in places with easy access.

Information about mule deer is collected a variety of ways because of differences in terrain, weather (snow cover), the timing of breeding and fawning, and road density (roadless areas are more difficult to survey on foot).

Why count mule deer? A great deal of time and effort can go into determining the ratio of bucks to does and fawn to does, and estimating total population and fawn recruitment. This information is used to develop harvest strategies that biologists hope will result in a healthy population of mule deer that the habitat can support.

One of the first steps in managing mule deer populations throughout the West is figuring out what everyone uses to base their management, policy and harvest decisions. Members of the Western Association of Fish and Wildlife Agencies (WAFWA) Mule Deer Working Group set to work to uncover this information.

They asked western states and Canadian provinces to answer questions about data collection, methodology, modeling and range condition. The results are eye opening.

Mule deer running during a helicopter survey across an area of northern Nevada that was burned and unsuccessfully reseeded. By Ken Gray.

To survey mule deer, western states and Canadian provinces are using everything from fixed-wing aircraft and helicopters, to horses, trucks and good old-fashioned feet. Some are using specific aerial techniques such as quadrats or double counts, while other states aren't using planes or helicopters at all. Some are using a sampling design based on ease of access, while others are more rigid in their sampling protocol. Some are sampling units once per year, while others are surveying twice a year or once every three years. The good news is that western states and provinces know what and how much work needs to be done to improve survey information on mule deer.

How is the data used after it is collected? Most states analyze their data using computer models to estimate population and determine the number of mule deer that should be harvested each year, and any changes in hunting regulations that may be necessary as a result of population estimates. Harvest data from the previous year, in combination with population estimates, are the most common factors states and provinces use to determine annual harvest levels.

The working group developed a series of recommendations to encourage states and provinces to work together to collect and analyze data about mule deer populations.

- Strive to obtain more standardized population measures.

- Each state and province should develop a prioritized list of mule deer populations and measures to estimate those populations. They recommend estimating fawn survival as the key parameter.

- Personnel who collect data should be trained and experienced.

- WAFWA should develop a set of guidelines and protocols to obtain and analyze mule deer harvest data.

- Host a workshop for staff that uses computer models to encourage standardization.

Surveying wildlife populations like mule deer is difficult and complex, certainly not as easy as creating a recipe for fast food and replicating it. But if biologists are ever going to understand mule deer on a regional basis, surveying and monitoring their populations will need to be more consistent and standardized.

How Diet Affects Deer

There are two ways food can influence mule deer populations. The first is density dependent, or dependent upon the size of the mule deer population in relation to habitat. If a mule deer population becomes larger than the ability of the habitat to support it, it eats itself out of house and home, and the body condition and productivity of the animals decline. This happened on the Kaibab Plateau in Arizona, the classic textbook case of what can happen to mule deer populations if they become overpopulated.

The second way food can affect a mule deer population is density independent, meaning that numbers of mule deer are not the primary cause of declines in body condition or productivity. Examples of this include poor range conditions or when an area receives a large amount of rainfall that causes nutrients to leach from the range. Animals are able to ingest large quantities of plants, but the quality of those plants is poor and does not provide the animals with adequate nutrients.

If mule deer numbers are declining in one region of the West, taking a look at range conditions can provide solid clues to the cause. Knowing what mule deer eat, and the times of year they feed on certain foods, is equally important.

The main part of a mule deer's diet is shrubs and forbs, and about 10 percent is grasses. Because of this varied diet, mule deer forage across several different types of landscapes, increasing the size of their home range as forage quality decreases.

Biologists know that maintaining healthy body condition is critical to mule deer survival and reproduction. Body condition determines ability to survive severe winters, birth size and survival of fawns, and even sex of fawns. More female fawns are born to does in good body condition.

In addition to overall body condition, some nutrients such as phosphorus, calcium and selenium affect overall productivity. Inadequate amounts of calcium can inhibit antler growth or cause lower weight gains in fawns.

Although measuring body condition is time and labor intensive, the payoff is substantial. If biologists can accurately measure body condition of mule deer, they can better evaluate range conditions and predict whether mule deer populations will increase, decrease or remain stable. The bottom line is that reproduction rates for mule deer in high quality habitats is greater than those in poor habitats.

Body measurements and amount of fat and muscle give biologists clues to the condition of live animals. These measurements can be taken by analyzing the amount of fat in organs, proteins in blood, chemical makeup of urine, and measuring the amount of muscle and estimating cell mass. All give clues to an animal's body condition.

What can be done to enhance body condition of mule deer and improve mule deer population numbers?

- *Improve range habitat for foraging mule deer by setting back succession. This can be done using fire, grazing, equipment or chemicals. Early successional stages provide the best forage habitat for mule deer.*
- *Manage for a wide diversity of plants, especially forbs and browse, across a broad landscape so that mule deer can meet their year-round nutritional needs.*
- *Avoid supplemental feeding as a replacement for lost or poor habitat.*
- *Practice adaptive resource management. Changes in mule deer condition and productivity should be monitored and evaluated when habitat changes.*

Supplemental feeding- Just Say No

Anyone that has ever been a boy or girl scout has likely had the opportunity to build a bird feeder. Over 110 million Americans feed birds today, a pastime that makes it one of the most popular hobbies that knows no gender, age, or cultural boundaries. People enjoy feeding birds because it gives them an opportunity to view wildlife, and it makes them feel like they're helping wildlife survive, particularly in the winter.

People commonly make the mistake in thinking that feeding other kinds of wildlife, particularly species like mule deer, is equally helpful. When people see mule deer starving along the sides of roads in the midst of a severe winter, compassion makes them want to help the mule deer by feeding them hay. Like most things in life, this sounds like a simple solution. But it's not that easy, and in fact, supplemental feeding may do more harm than good to most deer populations.

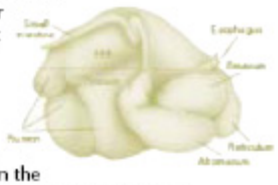
The key to understanding how supplemental feeding affects mule deer is to study their stomach, or as in the case of mule deer, stomachs.

Mule deer are ruminants with a four-part stomach. Each of the stomach chambers plays a critical role in the ability to process food.

The first stomach is called the rumen, a large storage chamber that reduces bigger pieces of food to smaller pieces through microbial action, much the same way that a compost pile 's microbes begin to break down leaves. Microbes are decomposers that break down matter into nutrients and minerals that plants and animals reuse.

While resting, mule deer regurgitate or "spit up" food from the rumen, and rechew their food. This is also known as "chewing their cud." Mule deer chew their cud to make the food they eat smaller, so that it can pass on to the next stomach, the reticulum.

The reticulum does two things. First, it acts as a filter, sending larger particles back to the first stomach for additional breakdown. And second, it breaks down the cell walls of plants, then passes the smaller food particles to the third stomach, the omasum.



The omasum also acts as a filter, sending particles that are too large back to the rumen. The third stomach absorbs water and compacts the smaller food particles for the fourth stomach, the abomasum.

The fourth stomach is a true stomach that functions much like a human stomach, where food is digested with acids, and the nutrients are absorbed through the intestines.

This well designed digestive machine even has a bypass for young mule deer that are not yet feeding on plants. Mule deer fawns bypass the first three stomachs and send the milk from their mother directly to their fourth stomach because there is no need for the first three stomachs to break down plant cell walls or make large pieces of food smaller.

Sounds pretty efficient? In some respects it is. Because of the number of stomachs, mule deer can get a large amount of protein and nutrients from the foods they eat. But this comes at a cost, and understanding the costs highlights the complexity of supplemental feeding.

The microbes that break down the food in a mule deer's stomach are very specific to the types of food the mule deer eats. Some microbes are good at breaking down woody plants, while others do a great job breaking down forbs.

During times of the year when mule deer are feeding on woody plants, their woody plant microbes are abundant in their digestive tract. When mule deer are feeding on forbs and grasses, other kinds of microbes roll up their sleeves and take the lead in digestion as woody plant microbes become less abundant.

Len Carpenter, Southwestern Field Representative with the Wildlife Management Institute, emphasized the importance of feeding mule deer the right type of food.

"With that smaller rumen, you have to provide them the right fiber mixture such that the animals can eat it without doing harm to the rumen," said Carpenter. "If you just feed them grains and hay, particularly low quality grass hay, there's a real problem."

A mule deer's digestive tract is so sensitive that natural climatic changes such as drought or excessive precipitation that can quickly change the quality and diversity of their foods can also result in malnourishment or starvation.

Does this mean that all supplemental feeding of mule deer is bad? Not necessarily, but be prepared to pay a hefty price for success. Supplemental feeding helps mule deer make it through a severe winter if the feeding is started early, long before the mule deer show signs of malnutrition or starvation. To effectively feed mule deer requires a three to four month commitment because it has to be started before poor range conditions and severe weather cause malnourishment. It must be continued until range conditions can support the herd.

These kinds of programs are costly, and can cause both short and long-term behavioral changes in wildlife. But the biggest threat to feeding mule deer is disease.

Mule deer and other big game animals that are fed by humans tend to concentrate at feeding sites, where disease outbreaks can affect a large number of animals. Mule deer are susceptible to chronic wasting disease and easily spread tuberculosis in crowded conditions (see article on Wildlife Diseases for a description of these diseases).

"The biggest problem right now with feeding are the disease concerns," said Carpenter. "That has become a big problem with tuberculosis and Chronic Wasting Disease. Michigan feeds and baits white-tailed deer and has a tuberculosis problem that affects their livestock. If you feed mule deer with elk, the brucellosis problems with elk and livestock are a real concern."

But Carpenter said there are some situations that are so severe for mule deer that consideration of supplemental feeding is warranted.

"There are some winter situations that are so bad, that if you don't feed, so many mule deer will die that a population won't be left, especially in high mountain areas," said Carpenter. "In very limited and extreme situations, it's okay to feed deer."

Disease isn't the only troubling side effect of supplemental feeding. Some mule deer are migratory, relying on traditional movements throughout a landscape to get the food, cover and water requirements they need year-round. Supplemental feeding can disrupt these movement patterns and cause mule deer that were once migratory to become year-round residents.

Year-round mule deer residents cause interactions human residents. Mule deer sometimes find alternative sources of food such as vegetable and flower gardens, and ornamental shrubs, much to the chagrin of homeowners. This problem can sometimes worsen during the spring, summer and fall. Numbers of vehicle/mule deer collisions can increase in areas where mule deer are fed.

Supplemental feeding can cause a population of mule deer to increase beyond the capacity of the range to support it. This causes overbrowsing of existing shrubs and forbs that has long-term effects on the range. Many areas, particularly those in and around deserts, take decades and often centuries to recover from overbrowsing.

If mule deer numbers remain artificially high during times when range conditions are poor, two things happen. First, the range takes longer to recover because overbrowsing continues. And second, the number of malnourished deer actually increases because artificial feeding causes more animals to survive and reproduce. More mule deer means more competition for existing resources. The only option for these animals is to feed in an overbrowsed range when they are not being supplementally fed.

The bottom line? Leave supplemental feeding to the birds, and plan for healthy mule deer populations by providing adequate year-round habitat for mule deer.

In severe winters and deep snow, it may be necessary to feed mule deer to prevent extreme losses. It is important that the ration fed is nutritionally balanced and that a feeding plan is in place. By Len Carpenter.

When mule deer feed across a large landscape, the microbes in their bodies adjust as their food sources gradually change. If a mule deer suddenly switches its diet from woody plants to high quality alfalfa hay, the microbes in its body do not have time to adjust, and it starves to death with a full stomach. Many a hay-fed mule deer has suffered this fate.

Learning by Doing

Managing Mule Deer with Uncertainty

The similarities between managing fish, forests and wildlife and playing the stock market are uncanny. When playing the stock market, you establish clear objectives for how you want your money to work for you over the long-term, then you tweak and make adjustments as changes in the market occur and new information becomes available. When you're managing species with fins, feathers, fur or leaves, the same conditions exist, including the inherent risks and uncertainties.

Biologists began to get a handle on describing the uncertainties of managing natural resources in the mid 1980s. Until that time, natural resource managers used a very traditional approach to managing fish, forests and wildlife that was often reactive and passive. The traditional approach was based on precise predictions, single answers, and the belief that management policies could be effective if they were long-term and stable. It was an approach destined for conflict and failure. It was a lot like dumping a large sum of money into one stock market fund, then walking away from it, despite changes in the economy, age to retirement and new information about stocks.

Biologists recognized the traditional approach was failing them in four basic ways.

- *They were not setting clear long-term management objectives;*
- *They were not monitoring the results of regulations, harvest and policies;*
- *They were not adjusting management activities based on the results of their actions and programs;*
- *And there was more conflict with the public who didn't have much opportunity to understand what agency managers did and why.*

These shortcomings created a system of managing wildlife that could be likened to a dog chasing its tail, where seasons and harvest "chase" habitat conditions and population levels. One of the biggest casualties of this approach to management was an uninformed public that expected wildlife populations to respond exactly to the predictions of biologists, a no-win situation for both parties.

Recognition of these shortcomings led to the birth of a new way of managing called adaptive resource management. Also called adaptive harvest management because harvest is often used to help regulate mule deer numbers, adaptive resource management introduces the uncertainty of managing natural resources - and attempts to minimize that uncertainty with consistent monitoring and evaluation of programs. In other words, it uses the "feedback" from past decisions and actions to make adjustments and future decisions.

The goal of this approach is to adapt management practices to fit the changing values of society, and the habitat conditions that affect our fish, forest and wildlife populations. It's a method of learning by doing that allows biologists to better understand how, for example, a watershed and the natural resources that live in that watershed respond to alternative policies and management practices. Using this approach can better define how a mule deer population responds to a specific land management practice and harvest program.

Adaptive resource management is a way managers can better meet goals, learn from and respond to management actions, and share that information so that others can benefit. There are four to six steps to adaptive resource management:

1. *Gather existing information about a population and its habitat, define a management objective, forecast outcomes of several management actions, and identify areas where knowledge and information is needed.*
2. *Design a management plan and monitoring program that will meet the desired management objectives, yield information where it is needed, and provide feedback about management actions.*
3. *Implement the plan.*
4. *Monitor the results of the plan.*
5. *Compare actual outcomes to forecasts and interpret results.*
6. *Make adjustments to forecasting models and management objectives to reflect new information and understanding. Repeat the process with adjustments.*

Helicopters are the vehicle of choice by biologists gathering data on mule deer populations. By Len Carpenter.

The first observations about adaptive resource management are that it isn't easy to do, it can be very costly for individual states, and it may be very difficult to coordinate throughout the West.

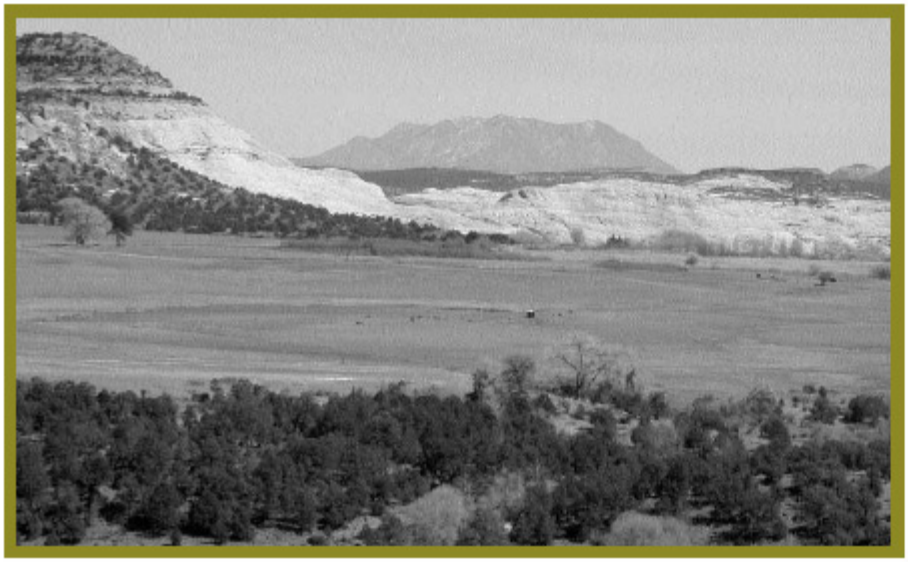
Len Carpenter is the Wildlife Management Institute field representative for eight states in the West and Southwest. He believes adaptive resource management would work well for mule deer, but recognizes there are inherent problems with implementing it across a large landscape with numerous political boundaries. Unlike waterfowl management, in which the United States Fish and Wildlife Service (USFWS) has key responsibility for management of migratory birds across all states, mule deer are state-regulated.

"The USFWS is one entity, and across all states they can dictate what can go on," said Carpenter. When it comes to mule deer management, "All states like to do their own thing. To impose the will of one system on all states collectively is difficult. Each state has its own agency and commission - those groups are all different, and they see things through different colored glasses. Adaptive resource management is going to have to be done state by state, recognizing that problems with mule deer are common across all states."

He cites the need for a multi-state approach to coordinate mule deer census, herd composition, fawn survival and harvests, and standardized data analysis. Goals for harvest management activities could include buck:doe ratios, fawn:doe ratios, or population densities. States could use these goals to develop models to evaluate the response of mule deer populations to different harvest and regulation strategies.

"Adaptive resource management per se is very complex and rigorous," said Carpenter. "It requires the establishment of objectives, the development of models, and monitoring and testing of models. Many states don't have the facilities or resources needed, and often can't follow all of the steps necessary to truly implement adaptive resource management."

Carpenter emphasized what adaptive resource management is not - "We'll try something, and if it doesn't work, we'll do something else." It's going to take time for western states and provinces to fully implement adaptive resource management.



Southern Utah desert landscape near Boulder, Utah. Henry Mountain is is the background. By Steve Cranney.

One of the first states out of the chute to apply adaptive resource management to manage mule deer is Montana. And they're taking the public along with them for the ride via their Internet site, www.fwp.state.mt.us/hunting/ahm/content.asp.

Anything and everything you ever wanted to know about adaptive resource management and how Montana is using it to manage their mule deer can be found on this site. One portion of the site is titled, "Mule Deer Hunters - Are You in the Know?" The site asks hunters questions, then provides a hyperlink with the answer.

The interested public can learn about surveying mule deer, using computer modeling to estimate population numbers, and managing herds using different harvest strategies. And through the use of questions and answers, Montana clearly explains that the driving force behind whether or not a mule deer herd is holding its own, shrinking or growing is the number of fawns that survive to adults.

Three to four month old mule deer fawns at Malheur National Wildlife Refuge, September of 1992. By Tom Keegan.

When asked about the management goal of Montana's mule deer, Montana doesn't throw out a number. Instead, they describe the long-term health of mule deer populations and optimal hunting opportunities.

The Big Sky state also does a great job of explaining that adaptive resource management is a work in progress. "With more consistent data collection on mule deer populations around the state and this computer modeling capability, biologists will increasingly be able to compare what is actually observed each year with what the computer modeling predicted the year before. Over time repetition of this modeling/in-the-field monitoring feedback loop will improve wildlife management performance by reducing the amount of uncertainty."

Glenn Erickson, Wildlife Management Bureau Chief for Montana, said public reaction on adaptive harvest management strategies for mule deer has been guarded.

"Everyone has accepted the process and the objectives as general consensus," said Erickson. " A lot of what people are doing is waiting. We haven't had a lot of complaints about the process or the directions we're going. The public has supported our approach to adaptive resource management process to this point. Things are good now as deer numbers are starting to increase."

Erickson commented that keeping people updated is critical. "Sometimes, what tends to happen is we put out an informational piece, and as we're halfway through implementation, some other crisis happens. By the time you get to a point where you have to have everyone supporting you, they or you have forgotten to keep people informed. To prevent that from happening, we developed an informational plan along with this process to keep everything in front of everybody."

Adaptive resource management can only be successful if state agencies take a proactive approach to keep interested constituents involved and informed.

Today, adaptive resource management is being used throughout the world to manage intercontinental waterfowl populations, quail, pronghorns, and mule deer, to name a few. Biologists are even using the concepts of adaptive resource management to conduct prescribed burns.

Will adaptive resource management ever be fine-tuned such that responses by wildlife to management activities will always be predictable? Not likely.

J.E. Mitchell and D.R. Freeman, in their 1993 technical report on wildlife-livestock-fire interactions on the Kaibab Plateau, said it best.

If western states and Canadian provinces can overcome the political and economic barriers to implementing adaptive resource management, both mule deer, and the publics that reap the benefits from healthy mule deer populations, will profit - even in the face of uncertainty.

"No matter how much data are collected and analyzed, some level of uncertainty will always exist. A land manager must make decisions with the information available and continue to learn from both mistakes and accomplishments."

Mule deer habitat along the Utah-Nevada border. By Steve Cranney.

Managing Deer Herds with Harvest

Hunting is the wildlife biologist's most often used tool to effect changes in the size and composition of mule deer populations. Establishing hunting seasons and harvests are within the control of fish and wildlife managers, and this activity generates much needed revenue for conservation programs.

The recipe for success to create effective hunts is to be very specific about the desired results. Harvest and population structure are monitored closely so that hunting seasons can be adjusted to properly manage mule deer herds. All of this must be done with the support of internal and external constituents. If any piece of this recipe is missing, it is very likely hunting will be ineffective in managing mule deer.

Some of the most useful harvest strategies include buck-only seasons, antlerless harvests, changes in season timing and length and limited licenses.

Buck-only seasons

Buck-only seasons generally have little effect on mule deer populations because the remaining bucks breed all reproductively active does. Wide buck:doe ratios and an abundance of younger males may delay the timing of breeding, but there is no evidence this significantly affects the reproductive rates of does or the number of fawns that survive to adulthood in a mule deer population.

Some people have expressed concern that heavy, buck-only harvest degrades the gene pool of a population, but there is no evidence to support loss of genetic diversity as a result of younger males breeding does. Buck-only seasons can effect changes in age structure, sex ratios, and timing of breeding, but these do not significantly affect the population as a whole. Under normal conditions, fawns are born at a time when habitat conditions are optimal. There is concern that if breeding is significantly delayed, fawns may be born late, and have a more difficult time surviving during winter.

Antlerless harvests

Doe harvests can be effective tools for managing population levels. Antlerless harvests can prevent large-scale die-offs or overbrowsing of habitat. The population has to be monitored closely, and the manager has to have reasonable estimates of population size, and adult and fawn survival. Each of these factors will allow biologists to use adaptive resource management techniques to manage mule deer populations and their habitats.

Biologists know that:

- *Harvesting does can be used to decrease a mule deer population depending on whether or not the removal of the does is additive or compensatory mortality. If the desire is to reduce the population, enough does must be harvested to reach the level where mortality is additive.*
- *By understanding how doe harvest affects a population of deer, managers can better meet population objectives within a habitat.*

Studies have shown that most environmental factors that reduce survival of fawns have little effect on adult does, which have a low natural mortality.

Season length and timing

Managing season length and timing are two methods managers have used to attempt to alter the age and sex structure of mule deer populations, especially when hunters become vocal about too many hunters, too few bucks or too few large bucks.

Restricting season length reduces hunter days in the field, but doesn't necessarily reduce buck harvest or improve buck:doe ratios.

Hunting seasons used to occur over relatively short periods of time. Today, many states and provinces offer a range of hunting seasons over a longer period of time and with a variety of harvest methods such as muzzleloader, archery and centerfire rifle. The purpose of expanded seasons is to offer additional types of hunter opportunity and reduce hunter densities to improve hunt quality and lessen landowner/hunter conflicts.

Antler point restrictions

Creating mule deer harvest seasons with antler point restrictions is popular amongst hunters who think it will help increase the number of mature bucks and buck:doe ratios in mule deer populations. But research in many western states shows that antler point restrictions do not produce more deer or larger-antlered deer.

Colorado implemented antler point restrictions statewide for six years, and in a number of game units for seven years. The result was a shift of hunting from pressure on all age classes of bucks (primarily yearlings) to bucks two years and older, and an increase in illegal or accidental harvest of yearling bucks. The number of mature bucks did not increase over time.

A successful mule deer hunt. By Dave Neill.

Idaho and Montana implemented two points or less seasons to reduce hunting pressure on older bucks and improve buck:doe ratios at the end of hunting seasons. Over the long term, two point seasons did not improve buck:doe ratios at the end of the hunting seasons.

Wyoming's experience with four point or better seasons resulted in fewer hunters and a reduction in total harvest, fewer mature bucks, and a significant number of deer harvested with fewer than four points.

Utah abandoned efforts to implement antler point restrictions after five years when officials documented illegal harvest, reductions in overall harvest and fewer mature bucks.

Attempts to increase the number of mature bucks and buck:doe ratios using four-point seasons in Montana reduced buck harvest by 28 percent, increased illegal harvest of bucks with 3x3 points or less by about 40 percent, and increased harvest of bucks having more than 3x4 points.

Washington tried antler point restrictions in a few of their hunting units and experienced a smaller harvest of mule deer bucks, a switch in harvest from mule deer to white-tailed deer, and no increase in the number of mature bucks. They did experience an increase in buck:doe ratios because of the lower buck harvest and improved recruitment of fawns.

Oregon abandoned antler point restrictions in a few popular hunting areas when the number of older bucks and buck:doe ratios decreased after 12 years.

Most western states have concluded that changes in buck:doe ratios and increases in the number of mature bucks can only be accomplished through reductions in harvest of bucks.

Limiting licenses

Limiting hunting licenses is another way to manage harvest and meet population objectives. In some areas, mule deer populations have not been able to keep pace with human populations, and demand for harvest exceeds availability. In these areas, biologists have little choice but to limit the number of hunting licenses.

In other areas, several years of severe weather forced states like Colorado to limit mule deer licenses. The state saw a corresponding increase in mule deer numbers as weather conditions improved and fewer mule deer were harvested.

By limiting licenses, fish and wildlife agencies offer fewer big game hunting opportunities, but can more effectively improve the number of large bucks, post-season buck:doe ratios and buck age structure.

Our Summary

As you worked your way through this publication, you may have realized that managing mule deer and public expectations is complex. The hey days of the 1950s, when fire and other natural forces enhanced habitat for mule deer and favored them over other species, are gone.

Given the permanent loss of winter and summer mule deer range that has occurred, it is not likely that we could ever return to mule deer population numbers that existed in middle of the last century. It is, however, possible to improve habitat management practices, reintroduce fires, reduce the spread of invasive species and focus on other factors that have contributed to the loss and decline of mule deer numbers. But it is also important to recognize that despite these and other well-intentioned efforts, many other factors such as climate are outside of human control.

Efforts to increase mule deer populations will require tremendous coordination that crosses political boundaries. These efforts may force each of us to make choices about expanding the communities where we live, or allowing exploration for minerals and gas in undisturbed wilderness.

The Western Association of Fish and Wildlife Agencies is facing the challenge with a cooperative, realistic approach in the hopes that stable, healthy mule deer populations can once again grace the western landscape for present and future generations.

WAFWA Mule Deer Working Group