

Brush Creek Deer Herd Management Plan Data Analysis Unit D-14

Game Management Unit 44



Prepared by:

Julie Mao (Terrestrial Wildlife Biologist)
Craig Wescoatt (District Wildlife Manager, Eagle-South)
Perry Will (Area Wildlife Manager, Area 8 *[now retired]*)

Colorado Parks and Wildlife
0088 Wildlife Way
Glenwood Springs, CO 81601

12/26/2019 draft



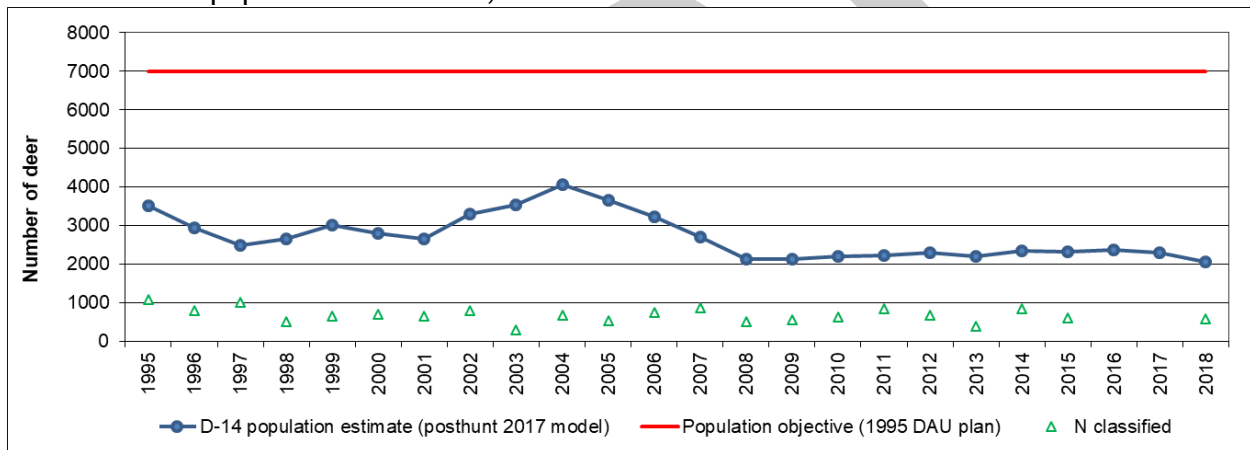
**LIVE LIFE
OUTSIDE**

Brush Creek Deer Herd Management Plan, DAU D-14

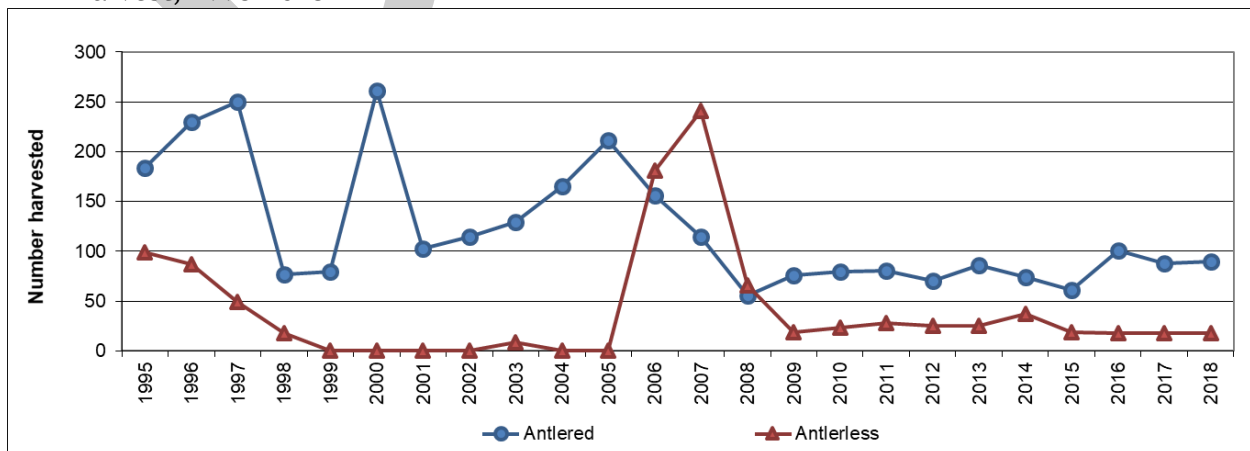
EXECUTIVE SUMMARY

Game Management Unit(s):	44
Current (1995 DAU plan) population objective:	7,000 deer
Current (post-hunt 2018) population estimate :	2,068 deer
Proposed Population Objective	
Alternative 1 (preferred):	1,500-3,500 (midpoint 2,500)
Current (1995 DAU plan) Sex Ratio Objective:	35 bucks per 100 does
Average of most recent 3-years' (2014, 2015, 2018) observed sex ratio:	47 bucks per 100 does
Proposed Sex Ratio Objective	
Alternative 1:	30-40 (midpoint 35)
Alternative 2 (preferred):	35-45 (midpoint 40)
Alternative 3:	40-50 (midpoint 45)

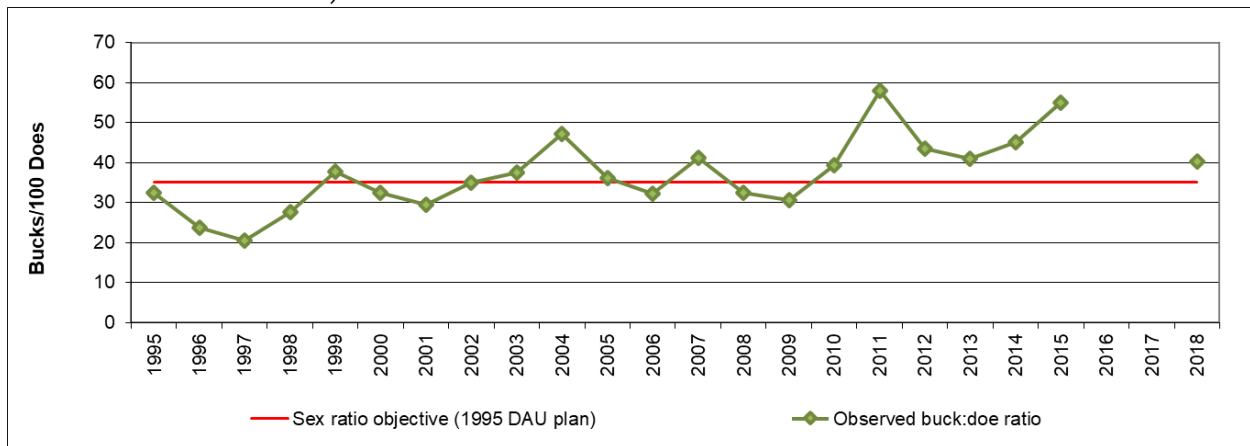
D-14 Post-hunt population estimates, 1995-2018



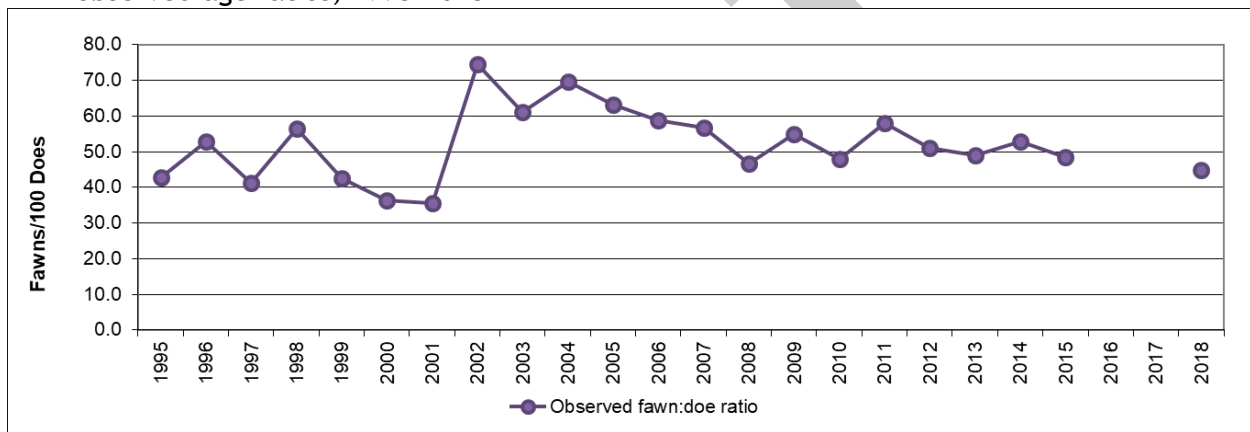
D-14 harvest, 1995-2018



D-14 observed sex ratios, 1995-2018



D-14 observed age ratios, 1995-2018



Background

The Brush Creek mule deer Data Analysis Unit (DAU) D-14 is located in Eagle County in northwest Colorado and consists of Game Management Unit (GMU) 44. D-14 covers an area of 976 km² (377 mi²), over 3/4 of which is public land. It is bounded on the north by the Colorado and Eagle Rivers; on the east by East Lake Creek; on the south by Red Table Mountain ridgeline; and on the west by Red Table Mountain Road, Cottonwood Pass Road, and Cottonwood Creek¹. Major towns within D-14 include Gypsum and Eagle. The town of Edwards is just outside of, but immediately adjacent to, the northeast part of the DAU. Interstate-70 follows the north edge of the unit. D-14 contains parts of the Colorado River, Eagle River, Lake Creek, and Cottonwood Creek and all of Gypsum Creek, Brush Creek, and Squaw Creek drainages.

This DAU has been managed to provide the highest quality buck hunting experience, defined as accessibility to public land with very low hunting pressure and a higher opportunity to harvest a mature animal. Drawing a 3rd or 4th season buck license in this unit is often perceived as a “once-in-a-lifetime” hunt opportunity.

¹ For a complete description of the boundaries of GMU 44, see page 4 of the main text of this document or any big game brochure.

When the current boundary of DAU D-14 was established in 1995, the population objective was set at 7,000 deer and the sex ratio objective was set at 35 bucks per 100 does. Since that time, the estimated population size has always been below objective, ranging from approximately 2,070 to 4,070 deer, or about -42% to -70% below the population objective. The population grew slightly in the early 2000s but then declined again from 2004-2008. Since 2008, the population has averaged 2,240 deer, or -68% below objective. The current (2018) post-hunt population estimate is 2,070 deer.

The sex ratio reached its objective by 2004 and was stable around the objective through 2010. A few years after buck licenses were reduced in 2008, the sex ratio began increasing above objective. The average of the 3 most recent years (2014, 2015, 2018) of observed sex ratios is 47 bucks per 100 does, which is 34% over objective.

Although the herd's objectives were established in 1995, D-14 has never had a formal written management plan. Given the significant changes in land use and the deer herd's current and potential performance, an update of D-14's management objectives is overdue.

Significant Issues

The major issues for this deer herd involve the cumulative effects of decades of human population growth and impacts of human activities on deer habitat in the Eagle River Valley. The result has been a loss of habitat quantity and quality and less solitude from human disturbance. The unit's carrying capacity for mule deer has declined compared to conditions in past decades when the current objectives were set over 2 decades ago. Significant issues include habitat loss and fragmentation from land development, declining habitat condition, and impacts of human recreation on deer. Other management concerns include the need to balance competing herd management objectives, potential for chronic wasting disease, and preference point "creep" over time.

Management Objective Recommendation

The current (2018) D-14 population estimate is approximately 2,070 deer and the current population objective is 7,000 deer. In the 24 years since the current objective was set, D-14 has never come close to achieving that population size and the past 10+ years of extremely conservative deer licenses have not resulted in any increase in population. CPW is proposing a new population objective range of 1,500-3,500 deer. This population objective is believed to be reasonably achievable under current habitat and land use conditions. CPW is recommending a sex ratio objective of 35-45 bucks per 100 does. This objective will continue to provide high quality buck hunting in the unit, but not be too high to pose problems with the health of the herd and its ability to recover from weather events or be resilient against disease outbreaks and other stressors.

Strategies to Address Issues and Management Concerns and to Achieve Herd Management Objectives

CPW will continue to work collaboratively with our partners in the federal land management agencies, private landowners, county governments, local municipalities and NGOs to protect and enhance the remaining mule deer habitat. Important habitat conservation methods include habitat treatments, conservation easements or land acquisitions, maintaining landscape connectivity and movement corridors, and adhering to seasonal recreation closures on winter range areas. To achieve the revised population and sex ratio objectives over the next 10 years, CPW will continue to set licenses annually, keeping in mind such issues as Chronic Wasting Disease and achieving a balance between maintaining high quality bucks and providing some additional opportunity for hunters to draw buck licenses in the high-demand seasons.

Table of Contents

EXECUTIVE SUMMARY	i
INTRODUCTION AND PURPOSE	1
Herd Management Plans	1
Population Dynamics, Maximum Sustained Yield, and Density Dependence	2
DESCRIPTION OF DAU	4
Location.....	4
Historic DAU Boundary Changes.....	5
Physiography	5
Climate and Precipitation	5
Topography	6
Ecoregion and Vegetation.....	6
HABITAT RESOURCE and CAPABILITIES	8
Land Status	8
Land Ownership	8
Habitat Distribution.....	9
Land Use	11
Outdoor Recreation.....	11
Land Development/Real Estate	12
Livestock Grazing	16
Logging	17
Habitat Capability and Condition.....	17
Conservation Easements	18
Conflicts with Agriculture	19
HERD MANAGEMENT HISTORY	19
Overview of Procedures to Estimate Population Size	19
Post-hunt Population Size	20
Post-hunt Herd Composition	20
Buck:Doe Ratio	20
Fawn:Doe Ratio.....	21
Hunting Licenses and Harvest Statistics	21
License Allocation.....	21
Harvest and Success Rates.....	23
License Demand and Preference Points	24
Land Access and Refuges from Hunting.....	25
CURRENT HERD MANAGEMENT, ISSUES, and STRATEGIES	25
Recreation Impacts.....	25
Habitat Loss and Fragmentation from Land Development.....	26
Habitat Condition.....	26
Competing Herd Management Objectives: Buck Ratio and Population Growth.....	27
Chronic Wasting Disease Status.....	27
PUBLIC INVOLVEMENT.....	28
Draft Plan public comment period, late September - October 2018	29
MANAGEMENT ALTERNATIVES and PREFERRED OBJECTIVES	30
Proposed Population Objective	30
Sex Ratio Objective Alternatives	30
Preferred Alternatives and New Objectives	31
STRATEGIES TO ADDRESS ISSUES AND MANAGEMENT CONCERNS	32
STRATEGIES TO ACHIEVE HERD MANAGEMENT OBJECTIVES	32
ACKNOWLEDGEMENTS.....	32

LITERATURE CITED 33

APPENDICES 35

 Appendix A. Human population in Eagle County, Colorado, 1920-2010..... 35

 Appendix B. Results of online hunter questionnaire, Oct-Nov 2017..... 35

 Appendix C. Results of public comment period questionnaire, Oct 2018. 35

 Appendix D. Comment letters from other agencies and committees. 36

Figures

Figure 1. “Management by objectives” process used by CPW to manage big game populations on a DAU basis. 1

Figure 2. Sigmoid growth curve. 2

Figure 3. Maximum sustained yield (MSY) occurs at a moderate population size due to density-dependent population growth rate processes. 3

Figure 4. Location of mule deer DAU D-14..... 5

Figure 5. Vegetation classes in mule deer DAU D-14..... 7

Figure 6. Land ownership in mule deer DAU D-14. 8

Figure 7. Mule deer summer range in DAU D-14. 9

Figure 8. Mule deer winter range, winter concentration areas, and severe winter range in DAU D-14. 10

Figure 9. Recreation trails and roads in mule deer DAU D-14, depicted with a 200-meter buffer zone of human disturbance. When deer are 200 m from a trail, there is an estimated 50% chance that the deer will flee if they encounter a hiker or biker (Taylor and Knight 2003). In addition, trails and roads divide once-continuous wildlife habitat into smaller, disconnected fragments. 12

Figure 10 (a-e). Housing densities in mule deer DAU D-14 from 1970-2010. 15

Figure 11 (a & b). Housing densities on private lands in D-14 on (a) overall mule deer range and (b) mule deer winter range..... 16

Figure 12. Conservation easements in mule deer DAU D-14. 19

Figure 13. Post-hunt population size estimates in mule deer DAU D-14, 1995-2018. 20

Figure 14. Post-hunt buck:doe ratios observed in mule deer DAU D-14, 1995-2018. 21

Figure 15. Post-hunt fawn:doe ratios observed in mule deer DAU D-14, 1995-2018..... 21

Figure 16. Overall deer license quotas in mule deer DAU D-14, 1996-2019..... 22

Figure 17. Doe license quotas in mule deer DAU D-14, 1996-2019. 22

Figure 18. Buck and either-sex license quotas in mule deer DAU D-14, 1996-2019..... 22

Figure 19. Mule deer harvest in DAU D-14, 1996-2018. 23

Figure 20. Overall hunter success rates in mule deer DAU D-14, 2003-2018. 23

Tables

Table 1. Vegetation classes in mule deer DAU D-14 by National Land Cover Database (NLCD) classifications. 7

Table 2. Land ownership in mule deer DAU D-14. 9

Table 3. Mule deer winter range, winter concentration areas, and severe winter range by land owner category in DAU D-14. 10

Table 4. Habitat projects in DAU D-14. 18

Table 5. Minimum preference points needed to draw rifle buck licenses in D-14, 2005-2018. 24

Table 6. Draw statistics for D-14 licenses in 2018. 25

Table 7. Proposed population objective for DAU D-14..... 30

Table 8. Proposed alternatives for D-14 sex ratio objective..... 31

INTRODUCTION AND PURPOSE

Herd Management Plans

Colorado Parks and Wildlife (CPW) manages wildlife for the use, benefit and enjoyment of the people of the state in accordance with the CPW’s Strategic Plan and mandates from the Parks and Wildlife Commission and the Colorado Legislature. Colorado’s wildlife resources require careful and increasingly intensive management to accommodate the many and varied public demands and growing impacts from people. To manage the state’s big game populations, the CPW incorporates a “management by objective” approach (Figure 1). Big game populations are managed to achieve population objective ranges and sex ratio ranges established for Data Analysis Units (DAUs).

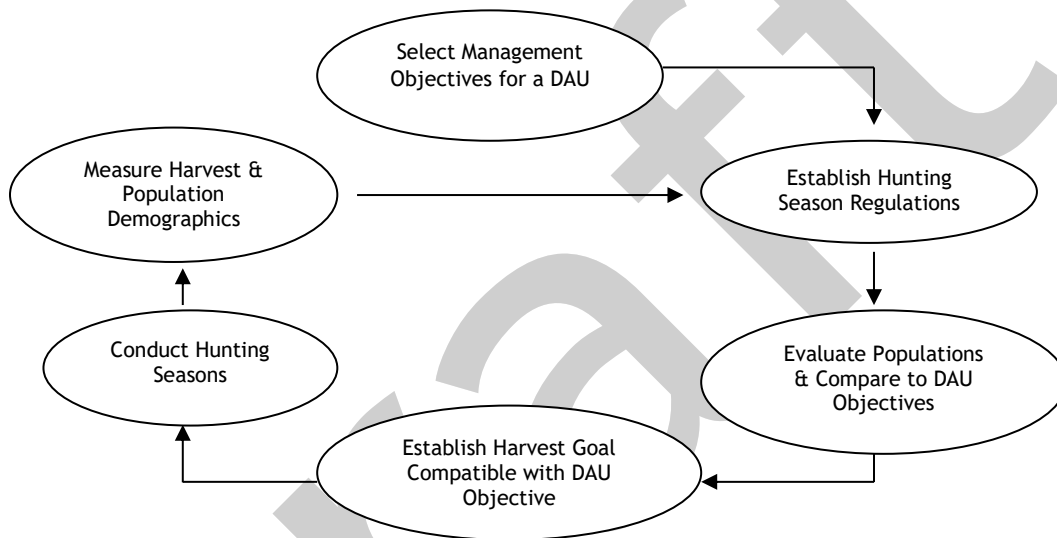


Figure 1. “Management by objectives” process used by CPW to manage big game populations on a DAU basis.

The purpose of a herd management plan is to provide a system or process which will integrate the plans and intentions of Colorado Parks and Wildlife with the concerns and ideas of land management agencies and interested publics in determining how a big game herd in a specific geographic area, i.e., the DAU, should be managed. In preparing a herd management plan, agency personnel attempt to balance the biological capabilities of the herd and its habitat with the public's demand for wildlife recreational opportunities. Our various publics and constituents, including the U.S Forest Service, the Bureau of Land Management, sports persons, guides and outfitters, private landowners, local chambers of commerce and the general public, are involved in the determination of DAU population and herd composition objectives and related issues. Public input is solicited and collected by way of questionnaires, public meetings and comments to the Parks and Wildlife Commission.

Most Data Analysis Unit or DAUs are the geographic areas that represent the year-around range of a big game herd and delineates the seasonal ranges of a specific herd while keeping interchange with adjacent herds to a minimum. A DAU includes the area where the majority of the animals in a herd are born and raised as well as where they die either as a result of hunter harvest or natural causes. DAUs can also be designated by specific management goals; such is the case with D-14. This DAU originates from the concept of

providing the highest quality hunting experience available. The Colorado Division of Wildlife of the 1990's selected, with community and public involvement, to manage certain Game Management Units for the highest quality experience. At that time, high quality meant accessibility to public land with very low hunting pressure and a higher opportunity to harvest a mature animal. This DAU continues to be managed and provide those factors to the public. Each DAU usually is composed of several game management units (GMUs), but in some cases only one GMU makes up a DAU. DAU D-14 is comprised of one Game Management Unit (GMU) 44.

The primary decisions needed for an individual DAU plan are how many animals should exist in the DAU and what is the desired sex ratio for that population of big game animals e.g., the number of males per 100 females. These numbers are referred to as the DAU population and herd composition objectives, respectively. Secondly, the strategies and techniques needed to reach the population size and herd composition objectives also need to be selected. The selection of population and sex ratio objectives drive important decisions in the big game season setting process, namely, how many animals need to be harvested to maintain or move toward the objectives, and what types of hunting seasons are required to achieve the harvest objective.

Population Dynamics, Maximum Sustained Yield, and Density Dependence

Numerous studies of animal populations, including such species as bacteria, mice, rabbits, and white-tailed deer have shown that the populations grow in a mathematical relationship referred to as the "sigmoid growth curve" (Figure 2). There are three distinct phases to this cycle. The first phase occurs while the population level is still very low and is characterized by a slow growth rate and a high mortality rate. This occurs because the populations may have too few animals and the loss of even a few of them to predation or accidents can significantly affect population growth.

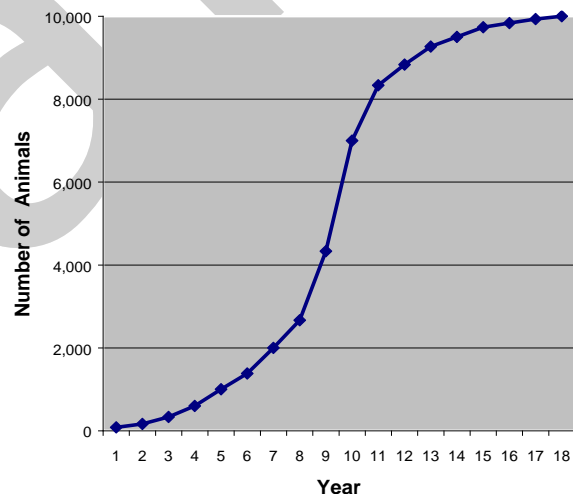


Figure 2. Sigmoid growth curve.

The second phase occurs when the population number is at a moderate level. This phase is characterized by high reproductive and survival rates. During this phase, food, cover, water and space are not a limiting factor. During this phase, for example, animals' body condition is usually excellent, age of first reproduction may occur earlier, and litter sizes can be higher. Survival rates of all sex and age classes are also at maximum rates during this phase.

The final or third phase occurs when the habitat becomes too crowded or habitat conditions become less favorable. During this phase the quantity and quality of food, water, cover and space become scarce due to the competition with other members of the population. These types of factors that increasingly limit productivity and survival at higher population densities are known as density-dependent effects. During this phase, for example, adult mule deer does may only produce one fawn rather than twins, and survival of all age-sex classes of

deer (bucks, does and fawns) will decrease. During severe winters, large die-offs can occur due to the crowding and lack of food. The first to die during these situations are fawns, then bucks, followed by adult does. Severe winters affect the future buck to doe ratios by favoring more does and fewer bucks in the population. Also, because the quality of a buck's antlers is somewhat dependent upon the quantity and quality of his diet, antler development is diminished. If the population continues to grow it will eventually reach a point called "K" or the maximum carrying capacity. At this point, the population reaches an "equilibrium" with the habitat. The number of births each year equal the number of deaths, therefore, to maintain the population at this level would not allow for any "hunnable surplus." The animals in the population would be in relatively poor body condition, habitat condition would be degraded from over-use, and when a severe winter or other catastrophic event occurs, a large die-off is inevitable.

What does all this mean to the management of Colorado's big game herds? It means that if we attempt to manage for healthy big game herds that are being limited by density-dependent effects, we should attempt to hold the populations more towards the middle of the "sigmoid growth curve." Biologists call this point of inflection of the sigmoid growth curve the point of "MSY" or "maximum sustained yield." In the example below, MSY, which is approximately half the maximum population size or "K", would be 5,000 animals. At this level, the population should provide the maximum production, survival, and available surplus animals for hunter harvest. Also, at this level, range habitat condition should be good to excellent and range trend should be stable to improving. Game damage problems should be lower and economic return to the local and state economy should be higher. This population level should produce a "win - win" situation to balance sportsmen and private landowner concerns.

A graph of a hypothetical deer population showing sustained yield (harvest) potential vs. population size is shown (Figure 3). Notice that as the population increases from 0 to 5,000 deer, the harvest also increases. However, as the population exceeds MSY (in this example, at 5,000 deer), food, water and cover becomes scarcer and the harvest potential decreases. Finally, when the population reaches the maximum carrying capacity or "K" (10,000 deer in this example), the harvest potential will be reduced to zero. Also, notice that it is possible to harvest exactly the same number of deer each year with 3,000 or 7,000 deer in the population. This phenomenon occurs because the population of 3,000 deer has a much higher survival and reproductive rate compared to the population of 7,000 deer. However, at the 3,000 deer level, there will be less game damage and resource degradation but fewer watchable wildlife opportunities.

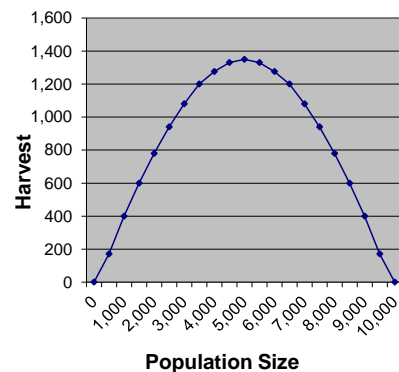


Figure 3. Maximum sustained yield (MSY) occurs at a moderate population size due to density-dependent population growth rate processes.

Actually managing deer populations for maximum sustained yield is difficult, if not impossible, due to the amount of detailed biological information about habitat and population size required. Additionally, carrying capacity is not static; the complex and dynamic nature of the environment cause carrying capacity to vary seasonally and annually. In most cases we would not desire true MSY management even if possible because of the potential for overharvest and the number of mature males is minimized because harvest reduces

recruitment to older age classes. However, the concept of MSY is useful for understanding how reducing population densities and managing populations near the mid-point of the habitat's carrying capacity can stimulate herd productivity and increase harvest yields. Knowing the exact point of MSY is not necessary if the goal is to manage toward the mid-range of possible population size. Long-term harvest data can be used to gauge the effectiveness of reduced population size on harvest yield.

Research in several studies in Colorado has shown that density-dependent winter fawn survival is the mechanism that limits mule deer population size because winter forage is limiting (Bartmann et al. 1992, Bishop et al. 2009). Adult doe survival and reproduction remain high but winter fawn survival is lower at higher population sizes relative to what the winter habitat can support. The intuition to restrict, or even eliminate, female harvest in herds in which population recruitment is low and when populations are below DAU plan objectives may actually be counterproductive to management goals and objectives. As Bartmann et al. (1992) suggest, because of density-dependent processes, it would be counterproductive to reduce female harvest when juvenile survival is low. Instead, a moderate level of female harvest helps to maintain the population below habitat carrying capacity (ideally on the "left" or lower side of MSY) and should result in improved survival and recruitment of fawns. Increased fawn recruitment allows for more buck hunting opportunity and a more resilient population.

Thus, the key for DAU planning and management by objective is to set population objectives in line with what the limiting habitat attributes can support. A population objective range appropriately set should be below carrying capacity.

DESCRIPTION OF DAU

Location

The Brush Creek Deer Data Analysis Unit (DAU) D-14 is located in Eagle County in northwest Colorado and consists of Game Management Unit (GMU) 44 (Figure 4). D-14 covers an area of 976 km² (377 mi²). It is bounded on the north by the Colorado and Eagle Rivers; on the east by East Lake Creek; on the south by the Frying Pan River-Eagle River hydrological divide (Red Table Mountain ridgeline); and on the west by FS Road 514 (Red Table Mountain Road), Eagle County Road 10A (Cottonwood Pass Road), and Cottonwood Creek.

Major towns within DAU D-14 include Gypsum and Eagle. The town of Edwards is just outside of, but immediately adjacent to, the northeast part of the DAU. Interstate-70 follows the north edge of the unit. Forest Roads 412 (Gypsum Creek), 400 (Eagle-Thomasville), and 514 (Red Table Mountain) provide access to the area. Part of the Holy Cross Wilderness is in DAU D-14. This unit lies in Eagle County. D-14 contains parts of the Colorado River, Eagle River, Lake Creek, and Cottonwood Creek and all of Gypsum Creek, Brush Creek, and Squaw Creek drainages.

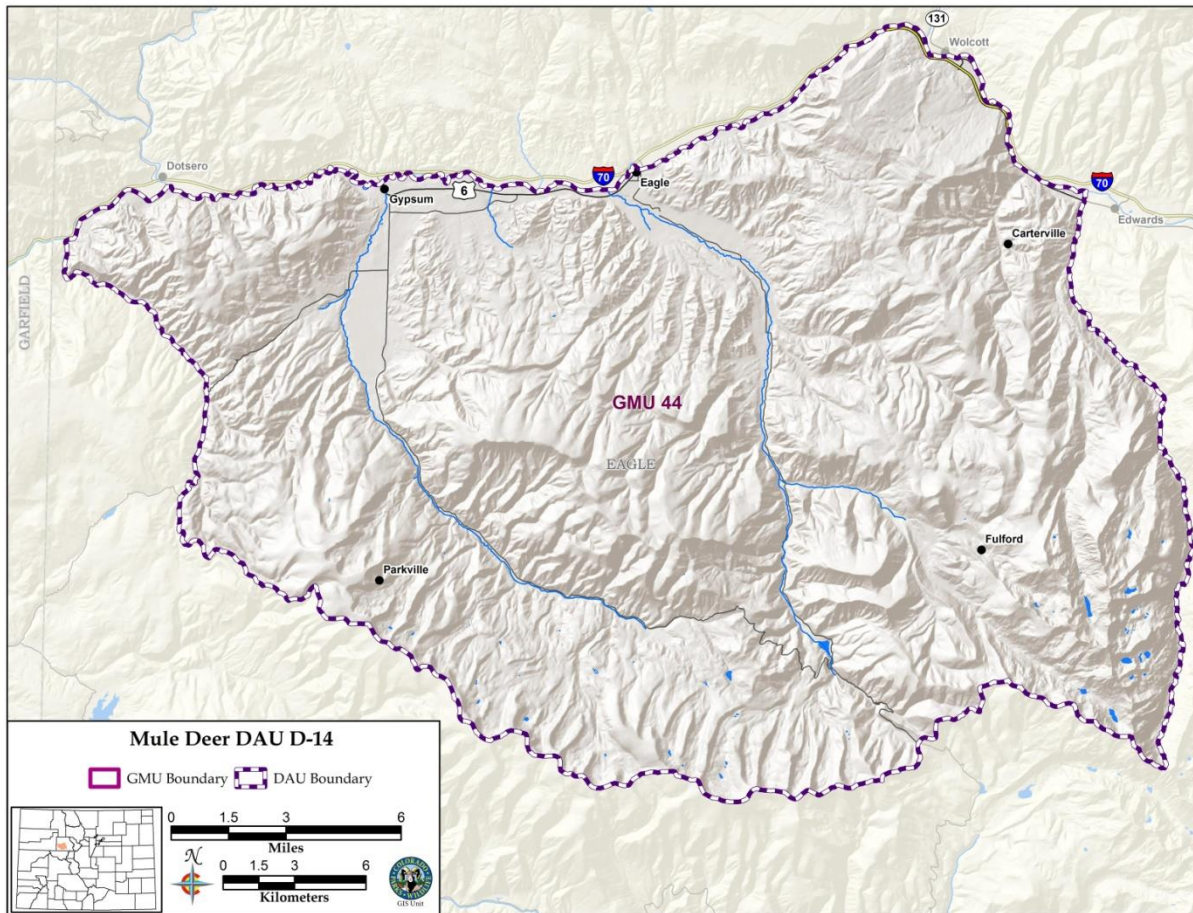


Figure 4. Location of mule deer DAU D-14.

Historic DAU Boundary Changes

Prior to 1980, the former boundaries of GMU 44 covered what is currently GMUs 44 and 444, and the whole area was managed as one DAU, D-14. In 1980, this GMU was split into the current GMUs 44 and 444, but continued to be managed as DAU D-14. During most of the 1980's the population objective was 18,000 deer. In 1988, the population objective was reduced to a more realistic and achievable level of 12,300 deer.

After GMU 44 became a totally limited license area in 1992, it was deemed necessary to make GMU 444 a separate DAU. This was accomplished in 1995, when DAU D-53 was created, containing GMU 444. The old population objective of 12,300 for both GMUs combined was split between the two new DAUs with D-14 being 7,000 and D-53 being 5,300 deer.

Physiography

Climate and Precipitation

The climate in D-14 varies with altitude. Low elevations in the valleys have moderate winters and warm summers. High elevations have long, cold winters and short, mild summers. Precipitation varies from about 10 inches annually at Dotsero in the Castle Peak/Flat Tops rain shadow to around 30 inches at 13,500 feet elevation. Prevailing winds are out of the

northwest. Snow accumulations at higher elevations force deer to migrate to lower elevations and/or south-facing slopes on winter ranges in the Eagle Valley.

Topography

The south half of DAU D-14 is mountainous and the terrain slopes down to the north to the Eagle River valley floor. The southeast portion of the unit is part of the west face of the Sawatch Range, and the southwest portion is Hardscrabble Mountain and the north slope of Red Table Mountain. The highest point is 13,365 feet above sea level at Gold Dust Peak and the lowest spot is about 6,100 feet at the Colorado River west of Dotsero. All natural surface water in this area drains into the Eagle River and the Colorado River. Major drainages include East and West Lake Creeks, Brush Creek, Gypsum Creek, and Cottonwood Creek.

Ecoregion and Vegetation

DAU D-14 lies within the Southern Rockies Level III ecoregion (Chapman et al. 2006). The vegetation in this unit is largely determined by elevation and aspect (Figure 5). Vegetation types by the National Land Cover Database classifications (Homer et al. 2015) are shown in

Table 1. The mountain peaks above approximately 12,500 feet are mostly bare rock or alpine communities. Spruce-fir forests dominate areas between the elevations of 10,000 and 11,500 ft. Aspen and aspen-conifer mixes dominate the slopes from 8,000 to 10,000 feet. Mountain shrubs show up on lower slopes between 6,000-8,000 feet. Pinyon-juniper woodland covers the foothills, and sagebrush parks appear on the more level sites as elevation drops. Riparian vegetation runs along the creeks and rivers. Mule deer prefer a diversity of vegetation types in close proximity to each other. These variations occur because of topography, microclimates, or natural disturbance factors such as wildfire.

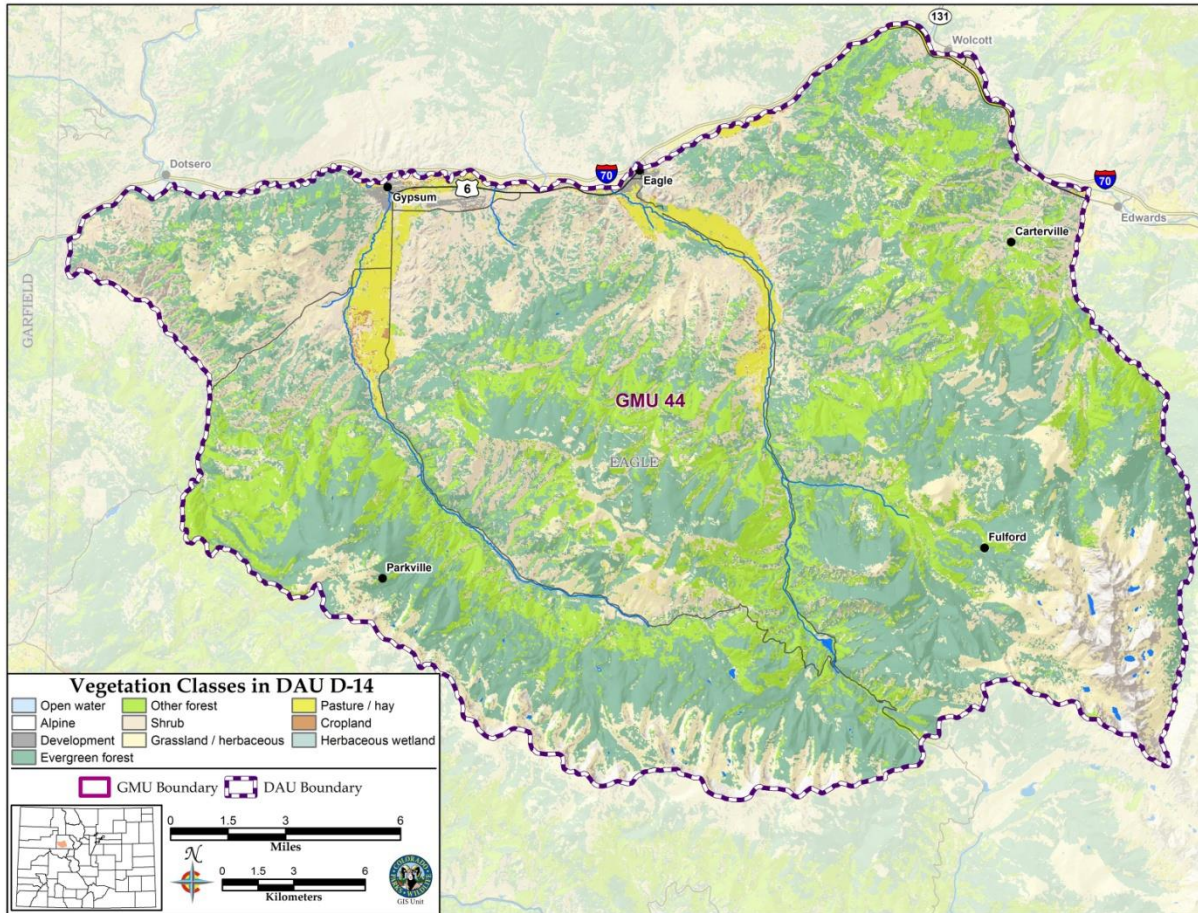


Figure 5. Vegetation classes in mule deer DAU D-14.

Table 1. Vegetation classes in mule deer DAU D-14 by National Land Cover Database (NLCD) classifications.

NLCD Vegetation Classification	Km ²	Mi ²	%
Evergreen Forest	416.8	160.9	42.7%
Other Forest	194.6	75.1	19.9%
Grassland / Herbaceous	174.0	67.2	17.8%
Shrub	123.9	47.9	12.7%
Barren	37.7	14.6	3.9%
Pasture / Hay	22.4	8.7	2.3%
Developed	2.9	1.1	0.3%
Cropland	2.5	1.0	0.3%
Open Water	0.9	0.4	0.1%
Alpine	0.2	0.1	0.0%
Herbaceous Wetland	0.0	0.0	0.0%
Total	976.0	376.8	100.0%

HABITAT RESOURCE and CAPABILITIES

Land Status

Land Ownership

DAU D-14 is predominantly public lands (Figure 6 and Table 2). Fifty-five percent of the land in this DAU is managed by the U.S. Forest Service (USFS; 536 km² or 207 mi²), primarily at the mid and upper elevations. At lower elevations, Bureau of Land Management (BLM) manages 23.3% of lands in the DAU (227 km² or 88 mi²) and another 21% is privately owned (201 km² or 77 mi²). The remaining 1.3% of lands is a mix of state, county, and non-government organization properties.

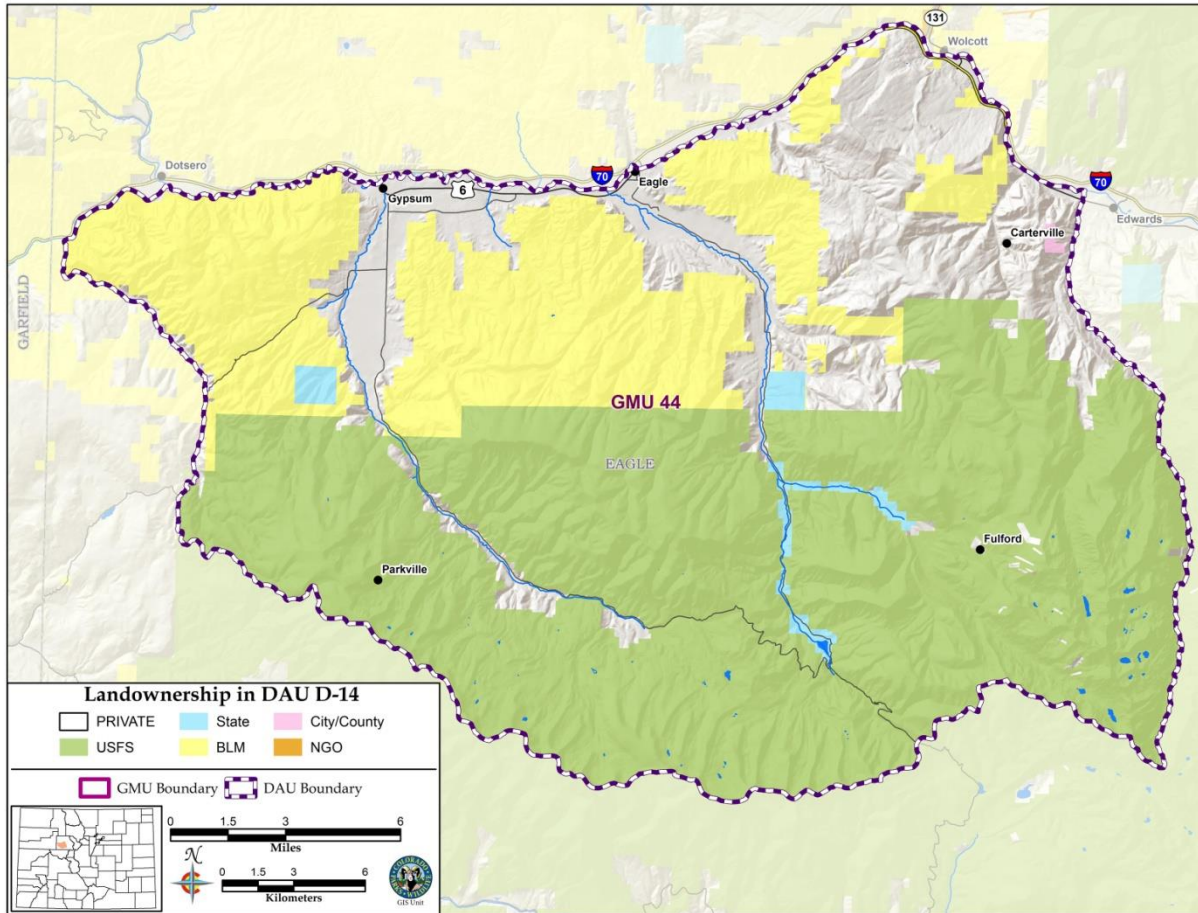


Figure 6. Land ownership in mule deer DAU D-14.

Table 2. Land ownership in mule deer DAU D-14.

Land Owner	Km ²	Mi ²	%
USFS	536.3	207.1	55.0%
BLM	226.7	87.5	23.2%
Private	200.5	77.4	20.5%
State Land Board	7.0	2.7	0.7%
CPW	4.7	1.8	0.5%
County	0.7	0.3	0.1%
NGO	0.1	0.0	0.0%
Total	975.9	376.8	100.0%

Habitat Distribution

Almost all (99.2%) of D-14, with the exception of the towns of Eagle and Gypsum and the Eagle Airport, is considered mule deer summer range (Figure 7).

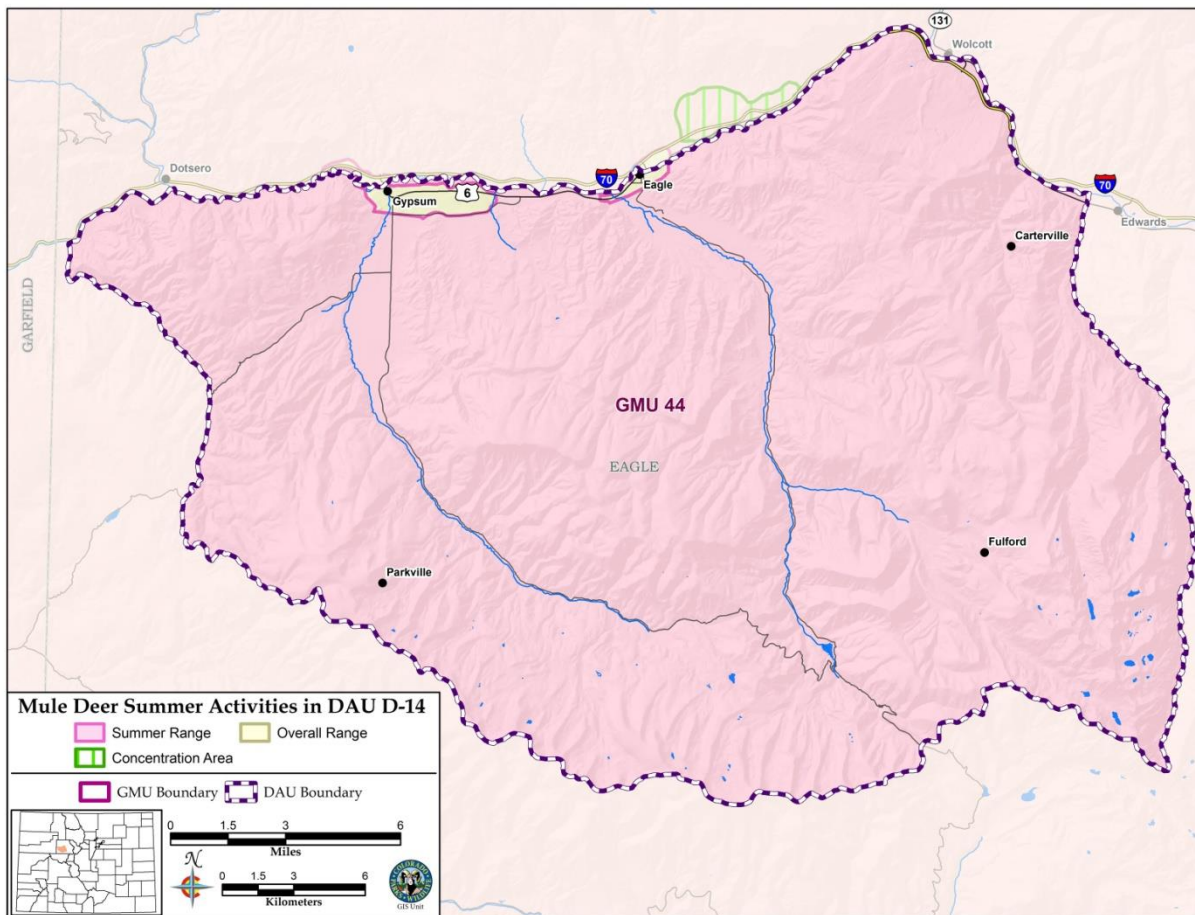


Figure 7. Mule deer summer range in DAU D-14.

Mule deer winter range comprises 43% of the DAU (Figure 8 and Table 3). Nearly half of winter range is on BLM lands; another 37% of winter range is on private lands; and 13% is on USFS lands. Nineteen percent of D-14 is considered winter concentration areas (defined as

areas on the winter range that have a density of at least 200% more deer than the surrounding winter range density in the average five winters out of ten), which fall almost entirely on BLM or private lands. Most of the winter concentration areas are also considered severe winter range (defined as that part of the overall range where 90% of the deer are located when the annual snowpack is at its maximum and/or temperatures are at a minimum in the two worst winters out of ten).

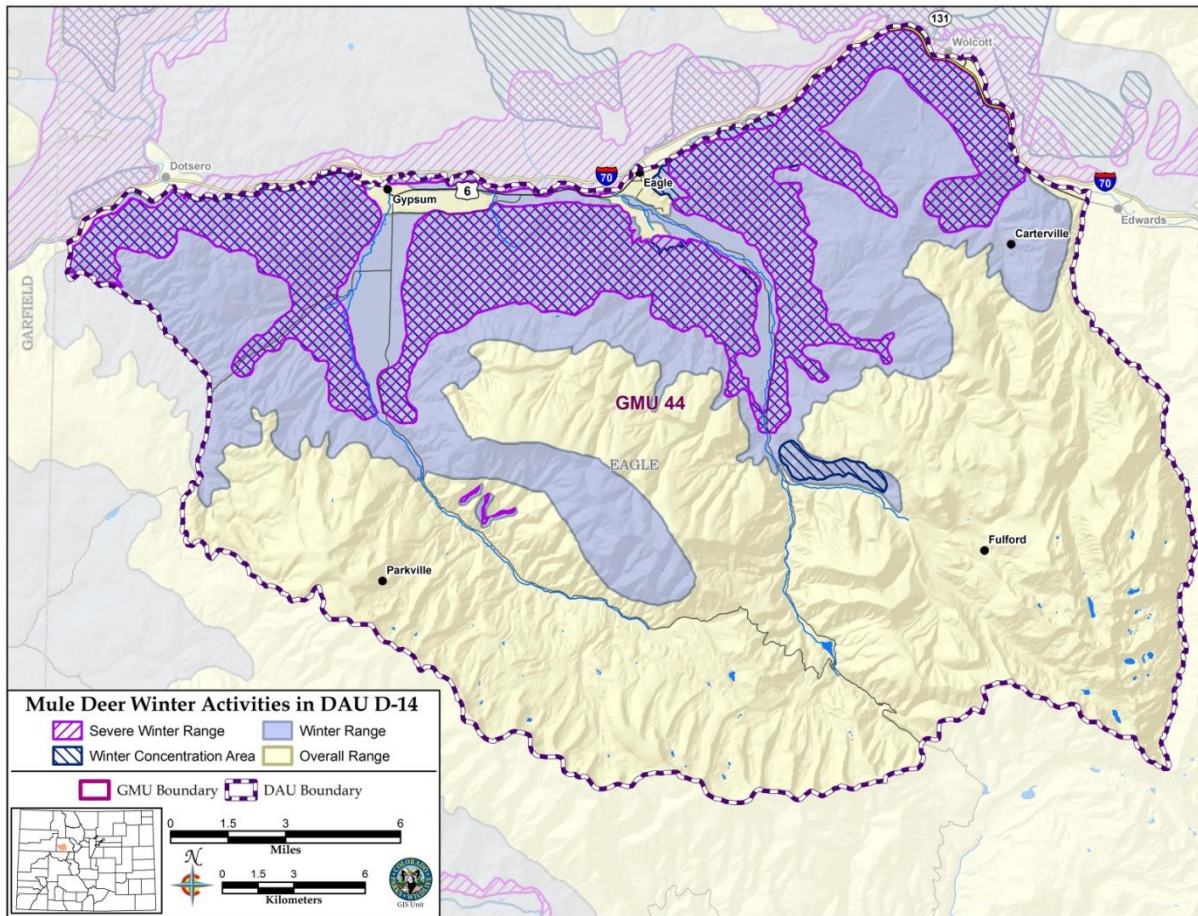


Figure 8. Mule deer winter range, winter concentration areas, and severe winter range in DAU D-14.

Table 3. Mule deer winter range, winter concentration areas, and severe winter range by land owner category in DAU D-14.

Land Owner	Winter Range			Winter Concentration			Severe Winter Range		
	Sq. Km	Sq. Mi.	%	Sq. Km	Sq. Mi.	%	Sq. Km	Sq. Mi.	%
BLM	201.1	77.6	48.2%	123.2	47.6	66.2%	123.7	47.8	67.1%
Private	153.0	59.1	36.7%	56.5	21.8	30.4%	57.6	22.2	31.3%
USFS	55.8	21.5	13.4%	4.1	1.6	2.2%	0.9	0.3	0.5%
State Land Board	5.7	2.2	1.4%	2.1	0.8	1.1%	2.1	0.8	1.1%
County	0.7	0.3	0.2%	0.0	0.0	0.0%	0.0	0.0	0.0%
CPW	0.5	0.2	0.1%	0.1	0.0	0.0%	0.0	0.0	0.0%
NGO	0.0	0.0	0.0%	0.0	0.0	0.0%	0.0	0.0	0.0%
Total	416.8	160.9	100.0%	186.0	71.8	100.0%	184.2	71.1	100.0%
Percent of DAU			42.7%			19.1%			18.9%

Land Use

Outdoor Recreation

The largest industry in the area is outdoor recreation. Every community along the I-70 corridor is promoting ecotourism and recreation on the federal lands adjacent to these towns. A major draw for many decades has been the ski areas (Vail, established in 1964, and Beaver Creek in 1981), bringing in both tourists and new residents relocating to mountain communities. Resort skiing continues to be a dominant driver of outdoor recreation, but in more recent years, other ecotourism-related activities have seen exponential growth, such that human recreationists are now a year-round presence on the landscape. These activities are diverse, including motorized, mechanized, horseback, and foot travel. Big game hunting, particularly “trophy quality” mule deer hunting draws hunters from all over the country. Hikers, campers, mountain bikers, motorcyclists, wildlife watchers, four-wheelers, snowmobilers, cross-country and backcountry skiers, trail-runners and dog-walkers all enjoy the scenic beauty of the mountains. Mountain biking events are now held on a weekly basis throughout the summer. Fat bikes have become popular in recent winters for cyclists to travel over snow-packed trails. Electric-assist mountain bikes (“e-bikes”) are appearing on the market, too; these bikes will allow people to travel further and faster with more ease. Fishermen enjoy the Eagle River and the numerous high lakes. Commercial raft guides operate on the Eagle River during spring runoff. Interstate-70 is on the north edge of the unit and is the major corridor through the mountains in Colorado and provides access for many vacationers. Motels, restaurants, gift shops, gas stations, and the local businesses benefit financially from these visitors.

In the past decade, many trails for mountain biking and motorized use have been constructed within D-14, with more trails being proposed every year. These networks of trails and roads fragment the habitat by bringing human activity further and more frequently into not just winter range, but now also transitional and summer ranges for deer and other wildlife (Figure 9). Updated federal land management plans have been adopted by both the BLM and the USFS in recent years (BLM 2015 and USFS 2012). Included in these plans were new travel management plans which decreased the miles of motorized trails or restricted use to designated trails. However, the BLM plan also designated Special Recreation Management Areas (SRMA); specifically within D-14, Hardscrabble and East Eagle SRMAs were established. SRMAs emphasize recreation as the primary desired activity within the designated areas and will allow motorized, mechanized, and pedestrian trails to continue to be constructed. In addition, areas which previously had limited human use have been developed to provide recreational opportunities, such as the Basalt to Gypsum motorcycle trail on USFS lands. All of these decisions and trends in recreation on public lands have resulted in an increased level of human activity throughout the DAU and the fragmentation of wildlife habitat. Wilderness areas and public lands have become such popular recreation destinations that solitude for wildlife from humans is almost non-existent.

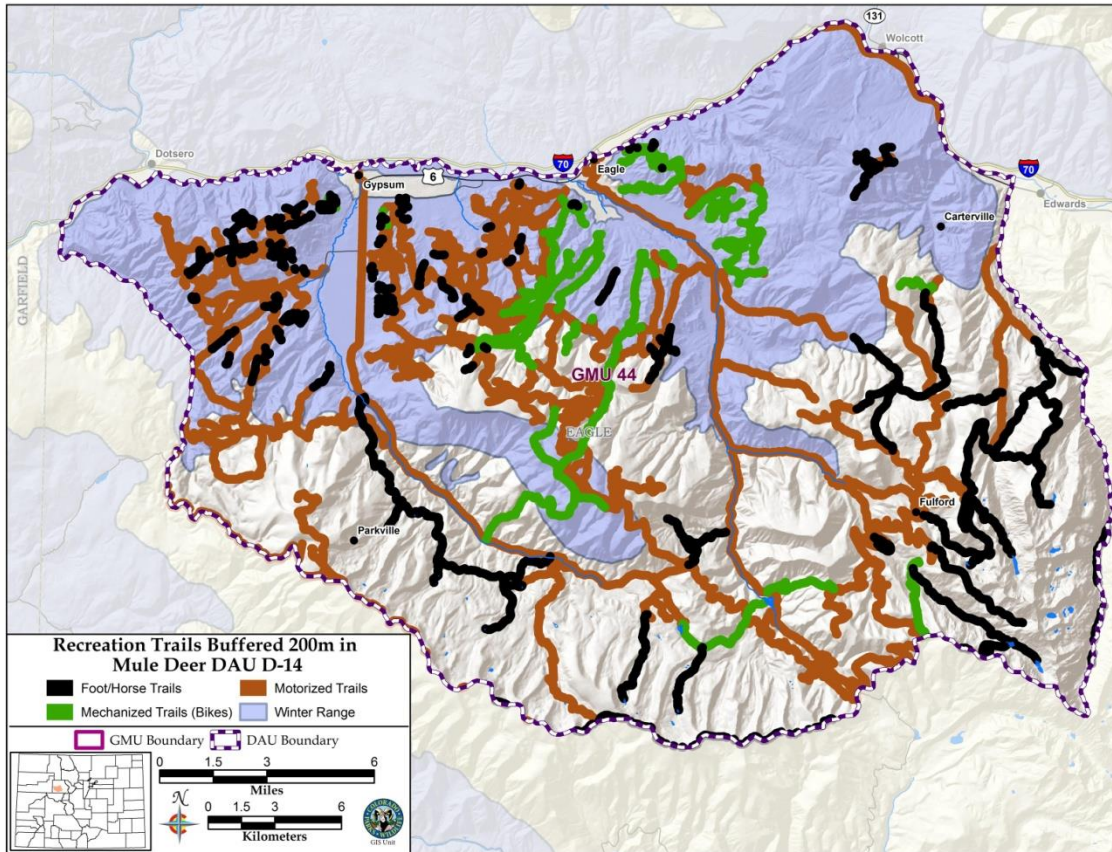


Figure 9. Recreation trails and roads in mule deer DAU D-14, depicted with a 200-meter buffer zone of human disturbance. When deer are 200 m from a trail, there is an estimated 50% chance that the deer will flee if they encounter a hiker or biker (Taylor and Knight 2003). In addition, trails and roads divide once-continuous wildlife habitat into smaller, disconnected fragments.

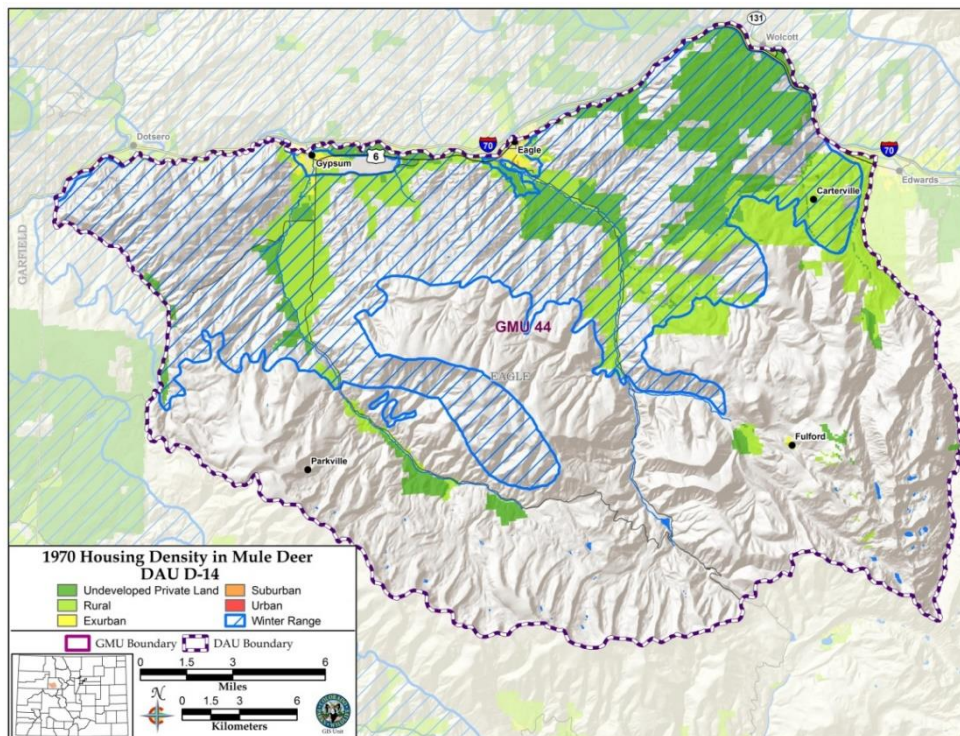
Land Development/Real Estate

Construction and real estate sales and development are the second largest industry in the area. The human population in the Eagle Valley has grown exponentially, increasing 11-fold since 1960 (Appendix A). Tourism and employment from the ski industry in the Vail area, which is immediately east of DAU D-14, led to a boom in residential housing development in the towns of Edwards, Eagle, and Gypsum. From the 1980s through the mid-2000s, many ranches were subdivided into housing developments, resulting in the loss of mule deer winter range acreage through conversion to residential development.

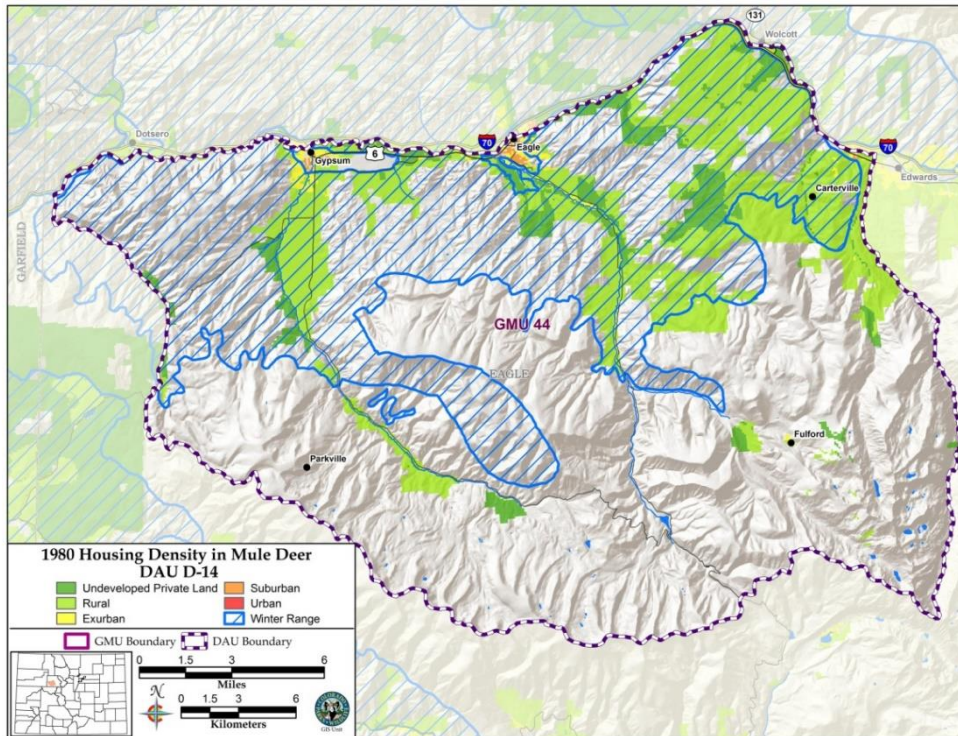
Housing density within mule deer winter range in D-14 and surrounding units has continued to grow, shifting from a once rural landscape to an increasingly ex-urban environment (Figure 10 & Figure 11). In 1970, only 2% of private lands on mule deer overall range and 1% of mule deer winter range in D-14 had housing densities considered to be ex-urban, suburban, or urban. By 2010, those percentages had grown to 34% of private land overall mule deer range and 29% of private land winter range (Figure 11). Notably, the amount of undeveloped (0 housing units per sq. km) lands declined from about half of private land area on both overall range and winter range to only 1% (Figure 11). Relating housing density to demographic trends in mule deer herds, Johnson et al. (2017) found as residential housing development in Colorado increased, mule deer recruitment rates declined.

By the late 2000s additional direct loss of winter range slowed down as much of the low-elevation private lands had already been developed. The “Great Recession” of 2008/2009 slowed down and even for a time stopped real estate development in the area. The continued in-fill development and build-out of approved developments within towns has resulted in increasing human populations but little direct loss of mule deer habitat. There have been several newer proposals and approvals of planned unit developments in the Eagle and Wolcott area but none of the proposals has broken ground. With the approval of the new developments there is a continued loss of working agricultural ranches within the unit.

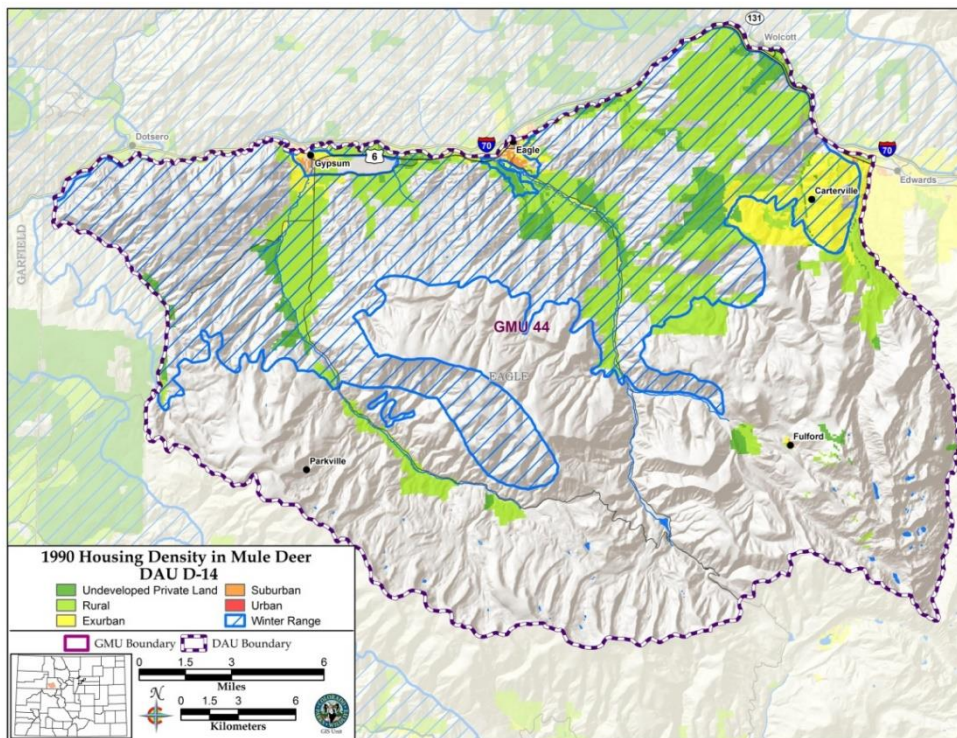
The unaccounted-for and often overlooked aspect of development is the indirect impact from the increasing human population and the desire to enjoy the surrounding scenic lands that also function as wildlife habitat. While new real estate development has been limited, the previously approved developments are nearing build-out and the in-fill within towns continues to occur to accommodate additional residents and visitors, impacting wildlife habitat either directly or indirectly. As more people occupy the landscape, they compete with wildlife for habitat, with the wildlife typically on the losing end. Loss and fragmentation of habitat, especially on deer winter range, has resulted in a lower habitat carrying capacity for deer.



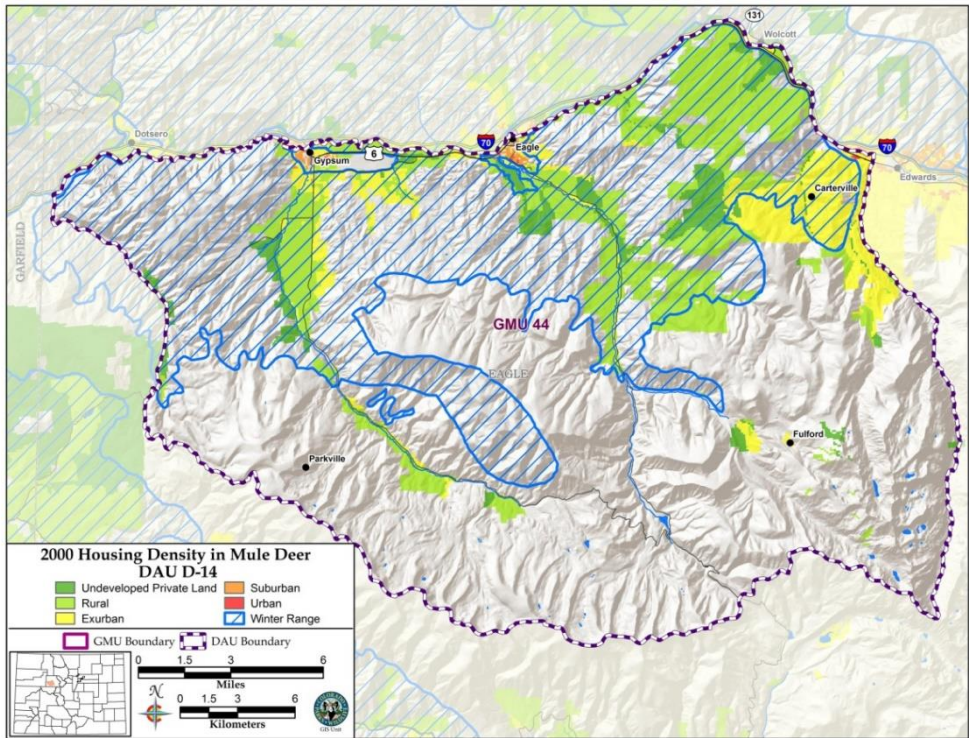
(a)



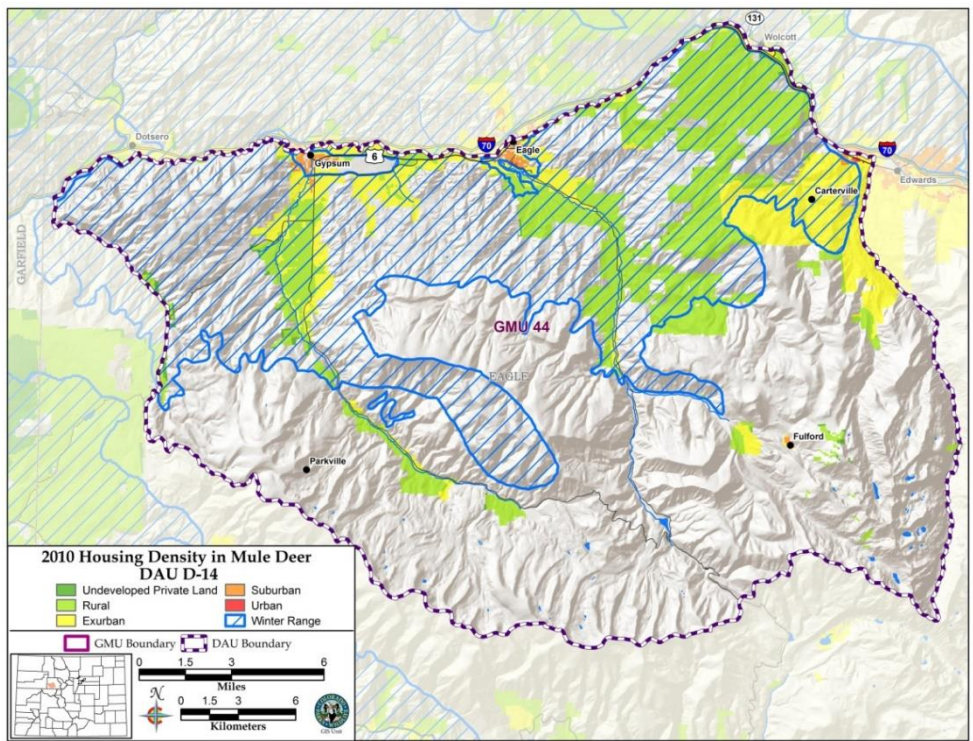
(b)



(c)



(d)



(e)

Figure 10 (a-e). Housing densities in mule deer DAU D-14 from 1970-2010. Data from GIS model developed by Sushinsky et al. (2014).



Figure 11 (a & b). Housing densities on private lands in D-14 on (a) overall mule deer range and (b) mule deer winter range.

Data from GIS model developed by Sushinsky et al. (2014).

Livestock Grazing

Public lands in the DAU are used for livestock grazing, although this use has declined with the general decline in agriculture in the DAU. Classes of livestock using these allotments are cattle and horses. There are 11 active BLM grazing allotments that are within or

significantly overlap the DAU. Use occurs primarily in the spring, summer, and fall. The USFS has 7 active grazing allotments occurring totally or mostly within the DAU. The period of livestock use is variable, but primarily occurs from late June through October. Domestic livestock can compete with mule deer and elk for herbaceous forage, although moderate levels of grazing can also help promote shrub growth by limiting grasses. Grazing practices have changed greatly since the 1960s. The impacts of livestock on the land are much less than earlier in the late 19th and early 20th centuries.

Some private lands are irrigated for hay production or are kept as dryland pasture. These private lands are beneficial to deer because they preserve open space in their winter range and can provide quality forage in the spring, fall, and winter. However, if un hunted, these properties (as well as landscaped suburban neighborhoods) can become refuges for deer from hunting pressure, making population management of local sub-herds of deer more complex.

Logging

Logging contributes only a very small part to the local economy. If done in a mosaic pattern, rather than clear-cutting, logging can benefit deer and elk summer range by increasing forage productivity for up to 10-20 years post-cut. Timber harvesting in the area has been ongoing since the 1900s. The 1950-60s spruce bark beetle outbreak killed the majority of mature spruce, and accessible areas were heavily logged through the late 1980s. In the past, timber stands were logged using a variety of methods including shelterwood, patch clearcut, group selection and salvage harvests. Current timber stands are composed of Engelmann spruce, sub-alpine fir, Douglas-fir, lodgepole pine, aspen and small amounts of Ponderosa pine. Most of the timber stands are mature and considered susceptible to insects, disease, and other stressors. Recent mountain pine beetle infestations in lodgepole pine stands have led to increased harvesting activities through clearcut, patch cut and sanitation/salvage harvests. In D-14, past logging centered in the Hardscrabble, Leeman Gulch, Fulford, and Billings Springs on Forest Service land. The BLM logged at the base of Hardscrabble Mountain in the past, and currently has no future plans for logging. The Forest Service is currently looking at logging the Fulford, Hardscrabble, and Billing Springs/Crooked Creek area within the next 10 years.

Habitat Capability and Condition

Deer winter range in D-14 is in poor to fair condition due to maturation and succession of plant communities, as well as habitat loss and fragmentation due to land development. As a result of decades of fire suppression and lack of large-scale habitat improvement projects, pinyon and juniper woodlands have encroached upon sagebrush shrublands and converted them to much less productive sites. Pinyon and juniper stands tend to be mature with a closed canopy that severely reduces understory vegetation. Also, many of the mixed mountain and sagebrush shrublands are over-mature and less productive. Browse seedlings and young plants are not abundant, and in many areas the grass/forb understory is sparse and lacks diversity.

Heavy livestock grazing, in combination with drought, occurred on many rangeland areas in western Colorado from the late 1800s to the 1960s. Since the late 1960s the BLM and USFS have developed improved grazing management approaches that have addressed many of the historic livestock problems. Also, due to the general decline in agriculture in the area, there is much less public land grazing today compared to 40+ years ago.

Higher elk populations in the 1990s and 2000s combined with loss of deer and elk winter range on private lands to land development resulted in higher elk densities on public land winter range for both deer and elk, which probably contributed to heavy browsing of shrubs. Heavily browsed shrubs are evident on winter range areas in some parts the DAU. However, in the past decade, warmer, drier winters have allowed elk to use mid-elevation areas that were historically traditional range during early and late winter. This distributional shift, along with the reduced elk population, has reduced some of the elk grazing/browsing intensity on mule deer winter range.

Land development along the I-70 corridor had been constant from the 1970s to the mid-2000s, resulting in significant loss and fragmentation of winter range habitat. While deer still might winter in these areas, the land is not as productive due to loss of habitat to roads, structures, fences, and vegetation alterations, and deer must face the added stress of human disturbance. The growth of residential developments adjacent to public lands has also made it more difficult to achieve habitat improvement projects because some homeowners object to habitat changes that will impact their views or otherwise affect their property.

The current pine bark beetle outbreak has affected portions of D-14. The USFS has several active or future timber sales intended to rejuvenate lodgepole stands by salvaging beetle-killed trees (see “Logging” section above). The death of bark beetle-killed lodgepoles and the consequent opening of the forest canopy are expected to enhance understory forage for deer and elk. This effect may at least partially substitute for forest fires as a habitat improvement, although nutrient cycling in burned vs. cut areas is not the same.

In recent years various small-scale habitat improvement projects, including prescribed burns, removal of pinyon-juniper encroachments, and improvement of sagebrush, oak, and mountain shrub habitats, have been conducted or are on-going (Table 4). Due to the loss and degradation of important deer (and elk) winter range throughout Colorado, the continued conservation and rejuvenation of existing habitat is paramount.

Table 4. Habitat projects in DAU D-14.

<u>Dates</u>	<u>Location</u>	<u>Acres</u>	<u>Treatment Type</u>	<u>Agency or Organization(s)</u>
Recent and ongoing habitat treatment projects				
2003	Bear Gulch	350	Fertilization	RMEF,HPP, mitigation trust
2005-2009	WRNF - Eagle burn block project, Dewey Park	712	Prescribed burns	USFS
2006-2007	Hardscrabble	2,000	Mountain shrub mowing, reseeded	Mule Deer Foundation, Eagle Ranch Wildlife Mitigation fund
2011-Present	Gypsum Habitat Treatments	1150	Seeding, Hydro-ax, Sagebrush Treatments	BLM, Town of Gypsum
Future anticipated treatments				
2021	USFS - Eagle burn block project, East Brush Creek unit	1,500	Prescribed burn	USFS

Conservation Easements

There are 19.7 sq. km. (7.6 sq. miles) of conservation easement lands in D-14 (Figure 12). These conservation easements constitute 10% of private lands and 2% of the total DAU’s area, almost all on mule deer winter range. Because winter range is highly limited in this DAU

and because of the high monetary incentive for development of private lands in this area, conservation of any remaining winter range habitat is imperative.

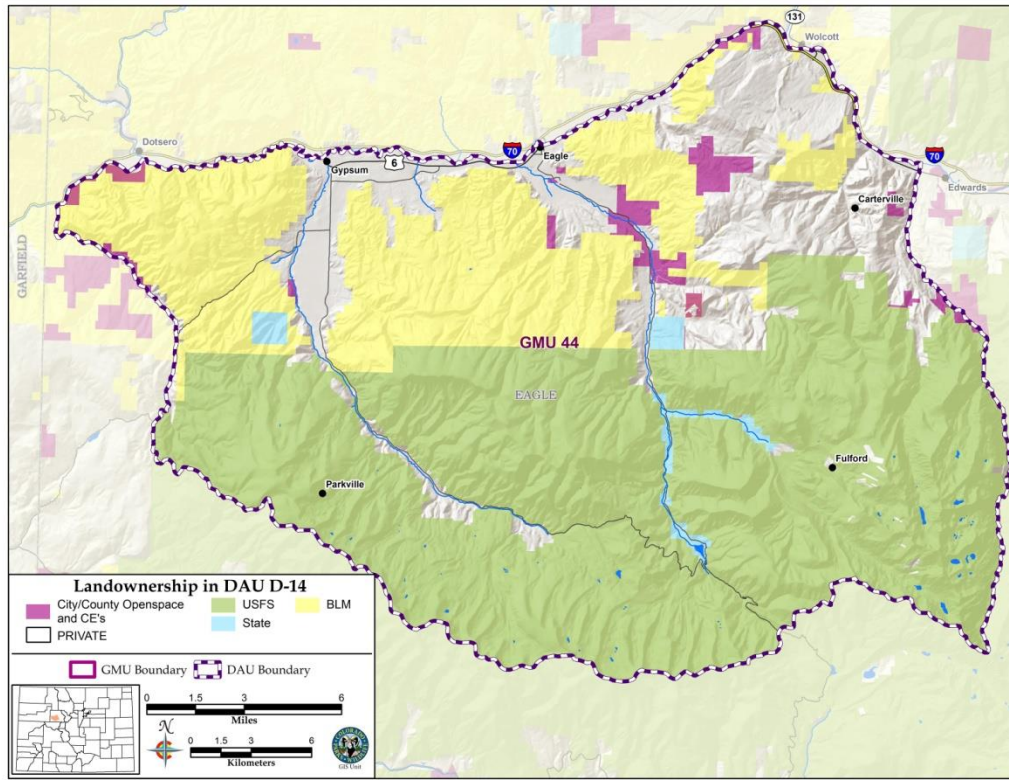


Figure 12. Conservation easements in mule deer DAU D-14.

Conflicts with Agriculture

There have been no game damage claims related to D-14 mule deer.

HERD MANAGEMENT HISTORY

Overview of Procedures to Estimate Population Size

Estimating population size of wild animals over large geographic areas is a difficult and inexact exercise. In several research projects, attempts have been made to accurately count all the known number of animals in large fenced areas. All of these efforts have failed to consistently count all of the animals. In most cases fewer than 30% of the animals can be observed and counted.

CPW biologists estimate deer population sizes using population modeling methods developed by White and Lubow (2002). These population models integrate multiple biological factors, including observed post-hunt sex and age ratios, hunter harvest, and estimated mortality rates and wounding loss rates. At present, these population modeling methods represent CPW's best estimate of populations. It is recommended that the population estimates presented in this document be used as an index or as trend data and not as an absolute estimate of the deer population in the DAU. As better information becomes available, such as new estimates of age-specific or sex-specific survival rates, wounding loss, may be derived in the future.

Post-hunt Population Size

When D-14 was established in 1995, the population objective was set at 7,000 deer. Since that time, the estimated population size has always been below objective, ranging from approximately 2,070 to 4,070 deer, or about -42% to -70% below the objective (Figure 13). Much of mule deer management is largely dependent on the combined influences of winter severity and harvest levels. The population grew slightly in the early 2000s but then declined again from 2004-2008, possibly due to increase in both buck and doe harvest (see “Hunting Licenses and Harvest Statistics” section below). Severe winters occurred in both 2007-08 and again in 2011-12 potentially adding to decreased herd health and vigor. Licenses were reduced from the mid- through late 2000s, leading to a stabilization of the population at a low level. Since 2008, the population has averaged 2,240 deer, or -68% below objective. The current (2017) post-hunt population estimate is 2,070 deer.

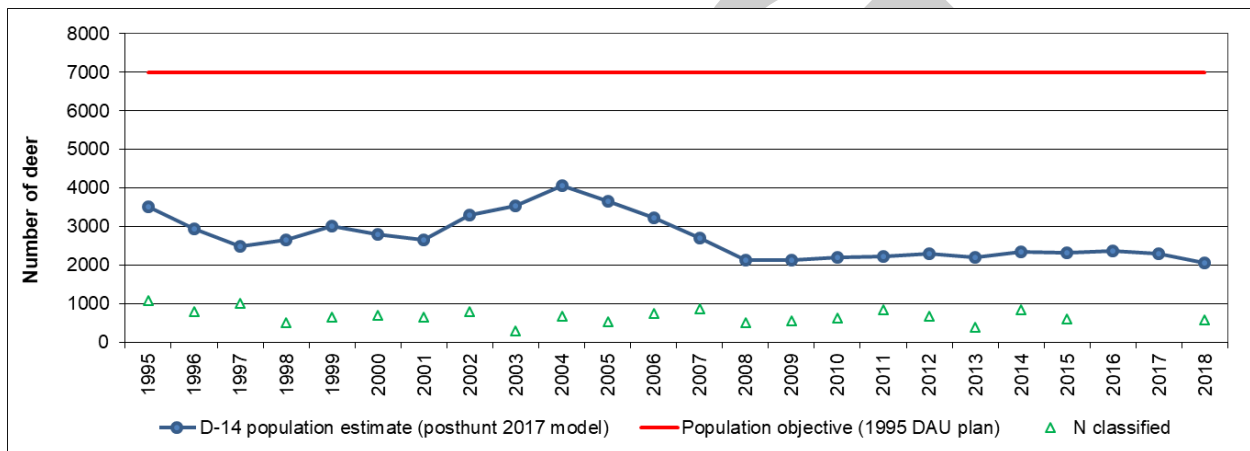


Figure 13. Post-hunt population size estimates in mule deer DAU D-14, 1995-2018.

Post-hunt Herd Composition

Buck:Doe Ratio

The buck ratio objective for D-14 was set at 35 bucks per 100 does when the DAU was established in 1995. By 2004, the 3-year average buck ratio reached this objective and was stable around the objective through 2010 (Figure 14). A few years after buck licenses were reduced in 2008, the buck ratio began increasing above objective. The most recent 3-year (2014, 2015, 2018) average is 47 bucks per 100 does, which is 34% over objective.

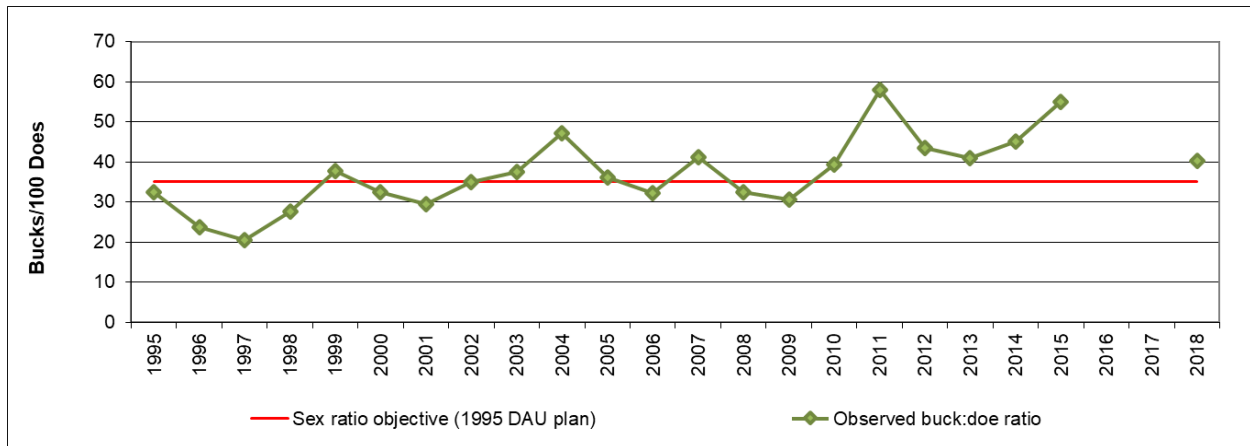


Figure 14. Post-hunt buck:doe ratios observed in mule deer DAU D-14, 1995-2018.

Fawn:Doe Ratio

The fawn:doe ratio in D-14 averaged 44 fawns per 100 does from 1995-2001, jumped up to 60-75 fawns:100 does from 2002-2005, and then since 2006 the ratio declined to 45-60 fawns:100 does with a variable but marginally downward trend (Figure 15). The most recent 3-year (2014, 2015, 2018) average is 49 fawns per 100 does. With D-14 having assumed survival rates of 0.869 (annual survival) for does and 0.654 (overwinter survival) for fawns, a fawn ratio of 49 fawns per 100 does should yield a stable population (Unsworth et al. 1999).

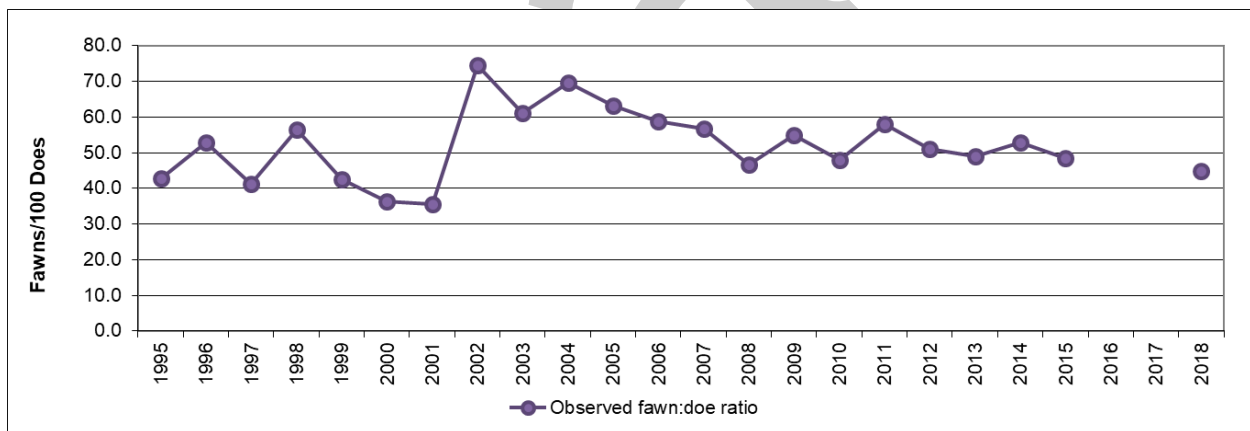


Figure 15. Post-hunt fawn:doe ratios observed in mule deer DAU D-14, 1995-2018.

Hunting Licenses and Harvest Statistics

License Allocation

Deer license quotas in D-14 have been set at fairly stable and relatively low levels with some adjustments made in 1997 and in the 2000s (Figure 16). In 2006, doe seasons were reinstated in the unit, after being closed to doe hunting in all years since 1999 except 2003 (Figure 17). But shortly after, in 2008 and 2009, doe licenses were reduced sharply. In 2015, doe licenses were further reduced to only 10 licenses per doe huntcode due to CPW Leadership Team’s direction to cut doe harvest in DAUs that were below population objective. Buck license quotas were reduced between 2006-2008 and have remained low but

stable since then (Figure 18). Because D-14 has been managed for a high buck ratio, buck licenses especially for 3rd and 4th rifle seasons have been kept intentionally very limited.

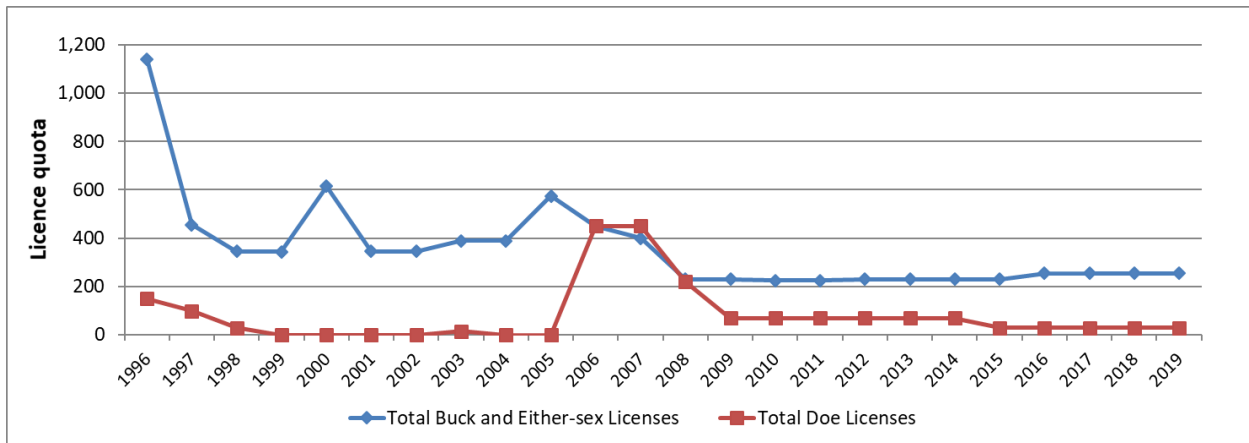


Figure 16. Overall deer license quotas in mule deer DAU D-14, 1996-2019.

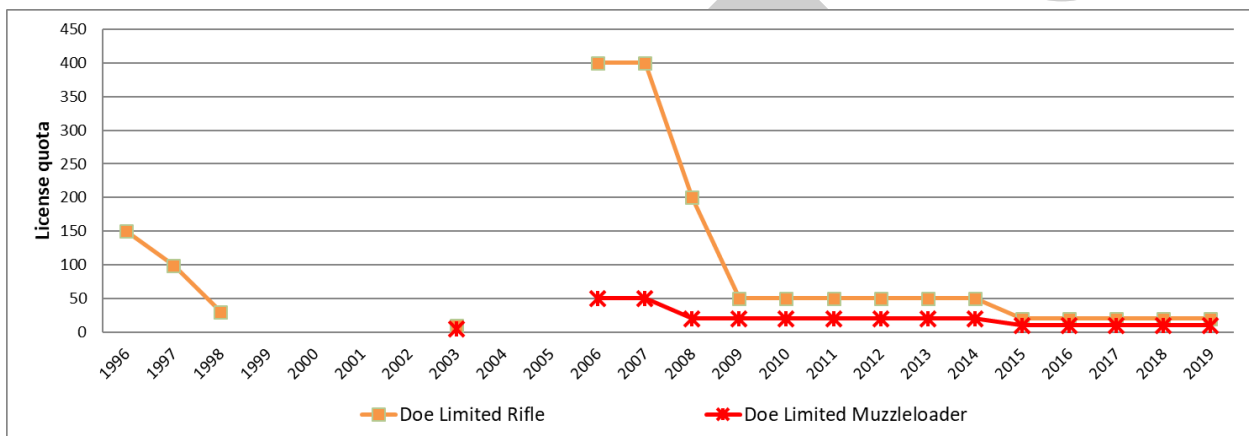


Figure 17. Doe license quotas in mule deer DAU D-14, 1996-2019.

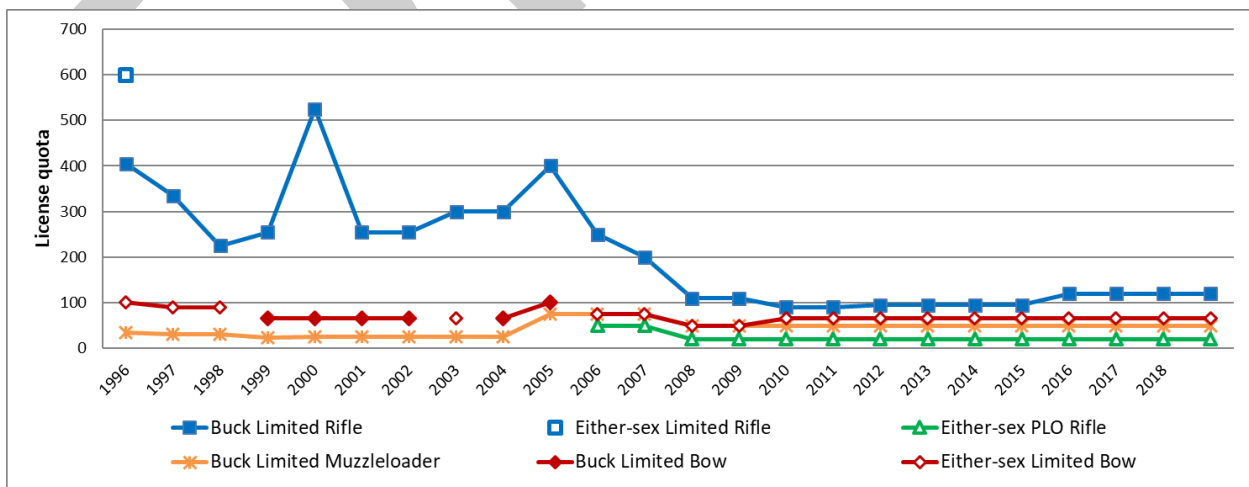


Figure 18. Buck and either-sex license quotas in mule deer DAU D-14, 1996-2019.

Harvest and Success Rates

Deer harvest in D-14 varies annually (Figure 19) based on both license availability (Figure 16-Figure 18) and success rate (Figure 20). The 3-year (2016-2018) average harvest in D-14 has been 93 bucks and 18 does + fawns. Note that some antlerless harvest comes from the either-sex private land only (PLO) seasons, so overall antlerless harvest can exceed the number of doe-only licenses.

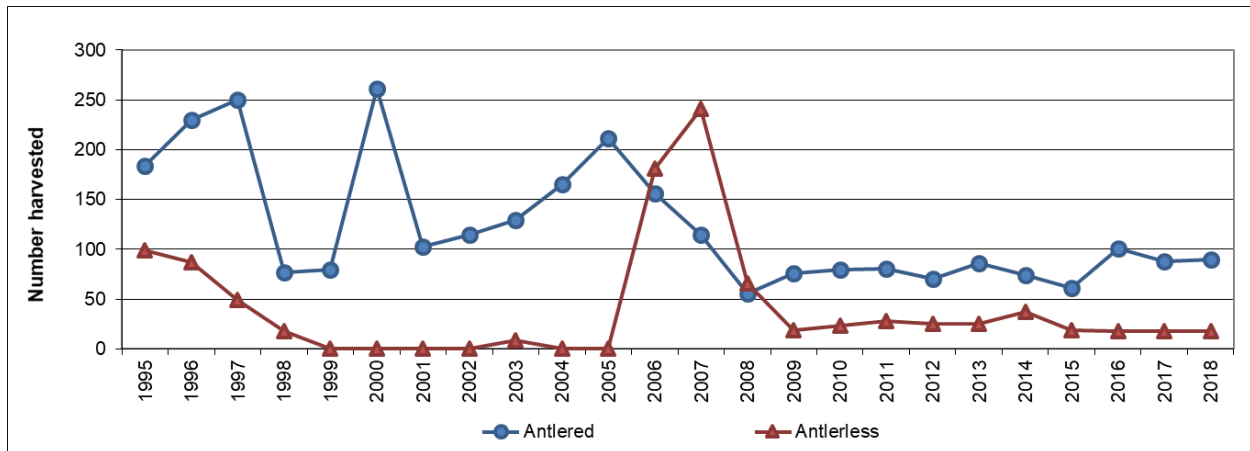


Figure 19. Mule deer harvest in DAU D-14, 1996-2018.

Success rates are primarily dependent on weather conditions. A wet summer with good growing conditions for plants allows deer to be more dispersed, whereas drought conditions may lead them to favor localized concentrations of wetter habitat such as near riparian areas and higher elevations. Snow cover can help hunters track deer, but can also limit road access. Rainy weather can deter some hunters. Later seasons generally see higher success rates because deer are becoming more concentrated on transitional and winter range and bucks in rut are more active and mobile.

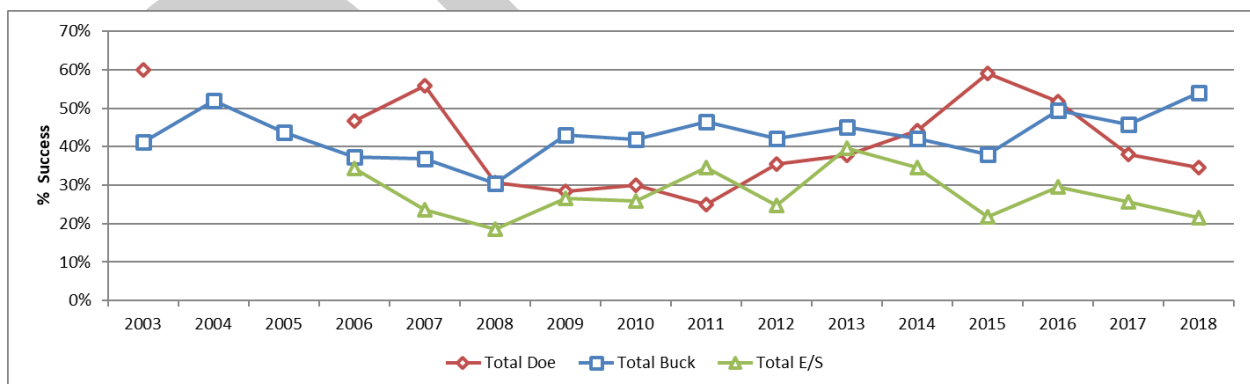


Figure 20. Overall hunter success rates in mule deer DAU D-14, 2003-2018.

License Demand and Preference Points

Having been managed as a “quality” buck unit, D-14’s licenses have been difficult to draw. The quotas for D-14 buck licenses are highly limited so that the unit can maintain older-aged bucks for harvest and to minimize hunter crowding for what may be a “once-in-a-lifetime” hunt, given the low draw odds for certain seasons. Because D-14 has been above its current buck ratio objective (see “Buck:Doe Ratio” section above), the herd could sustain higher buck harvest and more buck licenses, but buck license quotas have been kept very low for many years because of perceived crowding from other hunters and their friends helping to scout and from other types of outdoor recreationists.

Because of the high demand, preference points are needed to draw rifle buck licenses in D-14, especially for 3rd and 4th rifle seasons (Table 5). And as licenses became even more limited starting around 2006-2008 through present, the number of points needed has grown almost every year, leading to “preference point creep.” For a 3rd season buck license in 2018, residents needed at least 13 points and non-residents needed 21 points. Licenses for 4th season are in even higher demand, requiring at least 17 points for residents and 23 points for non-residents in 2018. There are many hunters who realistically might never draw a 3rd or 4th season GMU 44 buck license if the current quotas and draw system persist. A variety of solutions to the issue of preference point creep have been examined, including preference point banking, weighted points, ending the preference point system, increasing license quotas, or continuing with the current system. Some proposed solutions would continue to favor those who have waited and built up points over the decades, whereas others would make the chances of drawing based more simply on random likelihood within each year. Ultimately, there is no easy answer to resolving this issue that would satisfy all members of the hunting public.

Table 5. Minimum preference points needed to draw rifle buck licenses in D-14, 2005-2018.

D-14			Key:	0-4 Pts	5-9 Pts	10-14 Pts	15-19 Pts	20+ Pts	Year									
Season	Huntcode	Item	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018		
Early high country buck (Holy Cross Wilderness)	DM044E1R	Quota	25	25	25	25	25	15	15	15	15	15	15	15	15	15		
		Num.1st choice apps	137	137	124	134	111	126	99	102	106	106	103	131	115	115		
		Resident Pref Pts	4	3	2	2	2	3	3	3	4	4	3	5	5	5		
		Non-Resident Pref Pts	0	0	3	2	3	3	4	4	4	8	4	5	5	5		
Buck 2nd rifle	DM044O2R	Quota	200	125	100	50	50	50	50	50	50	50	50	65	65	65		
		Num.1st choice apps	310	229	301	291	214	188	228	237	204	204	175	209	206	203		
		Resident Pref Pts	0	0	1	2	2	2	2	2	2	3	3	3	2	2		
		Non-Resident Pref Pts	0	0	1	3	3	2	2	5	5	4	5	6	6	6		
Buck 3rd rifle	DM044O3R	Quota	150	75	50	25	25	15	10	15	15	15	15	20	20	20		
		Num.1st choice apps	548	461	444	359	265	374	310	270	273	330	299	385	300	332		
		Resident Pref Pts	2	2	3	4	5	6	9	9	9	10	11	12	13	13		
		Non-Resident Pref Pts	0	0	4	5	6	9	12	14	16	16	18	20	20	21		
Buck 4th rifle	DM044O4R	Quota	25	25	25	10	10	10	15	15	15	15	15	20	20	20		
		Num.1st choice apps	374	339	330	341	294	268	289	412	485	554	558	610	549	617		
		Resident Pref Pts	7	8	7	7	8	10	10	13	14	14	15	16	17	17		
		Non-Resident Pref Pts	0	0	10	11	10	14	16	19	18	19	20	22	22	23		

Besides rifle buck licenses, the either-sex archery, buck and doe muzzleloader, rifle doe, and either-sex private land only (PLO) licenses can be drawn usually with between 0 to 2 preference points (Table 6).

Table 6. Draw statistics for D-14 licenses in 2018.

Season	Hunt Code	# of Lics Sold	Sold Out	# of 1st Ch Apps	Drawn Out At in Primary Draw			
					Adult Resident	Adult Non-res.	Youth Resident	Youth Non-res.
Either-sex Archery	DE04401A	62	At Choice 1	150	1 Pref Points	1 Pref Points	Choice 4	No Apps
Buck Muzz.	DM04401M	43	At Choice 1	86	0 Pref Points	0 Pref Points	0 Pref Points	None Drawn
Doe Muzz.	DF04401M	9	At Choice 1	10	0 Pref Points	None Drawn	None Drawn	No Apps
Buck Early Rifle	DM044E1R	13	At Choice 1	115	5 Pref Points	5 Pref Points	5 Pref Points	No Apps
Doe 2 nd Rifle	DF04402R	10	At Choice 1	29	1 Pref Points	None Drawn	0 Pref Points	None Drawn
Doe 3 rd Rifle	DF04403R	10	At Choice 1	16	0 Pref Points	None Drawn	0 Pref Points	No Apps
Buck 2 nd Rifle	DM04402R	63	At Choice 1	203	2 Pref Points	6 Pref Points	2 Pref Points	None Drawn
Buck 3 rd Rifle	DM04403R	19	At Choice 1	332	13 Pref Points	21 Pref Points	None Drawn	None Drawn
Buck 4 th Rifle	DM04404R	19	At Choice 1	617	17 Pref Points	23 Pref Points	None Drawn	None Drawn
Either-sex PLO 2 nd Rifle	DE044P2R	7	At Choice 2	5	Choice 2	0 Pref Points	0 Pref Points	None Drawn
Either sex PLO 3 rd Rifle	DE044P3R	10	At Choice 2	5	Choice 2	10 Pref Points	No Apps	No Apps

Land Access and Refuges from Hunting

There is ample USFS and BLM public land, over 75% of the DAU, in D-14 with primary road access up Gypsum and Brush creeks, and Cottonwood Pass Road. However, many of these public lands are becoming less functional as wildlife habitat due to the increasing, often year-round use of public lands by recreationists of all types (see “Outdoor Recreation” section above).

While there may be a perception of private-land refuges from hunting, there are no areas where mule deer migrate, flee, or compile that could be conceived as an actual refuge. Private lands do provide some of the highest quality habitat, and as such, have substantial numbers of deer on those properties. However, in no way do these properties harbor the majority of deer or all the quality bucks in the DAU. There is more than adequate access and public land available to hunt and provide a quality “once in a lifetime hunt.” The perception may originate because “trophy” bucks are often visible or reported on social media on the private properties resulting in “a grass is always greener, private land has all the big bucks” attitude in some individuals.

CURRENT HERD MANAGEMENT, ISSUES, and STRATEGIES

Mule deer population management issues in D-14 have been discussed throughout this document in various earlier sections. The combination of these impacts on deer is that D-14 has lower-quality habitat and less solitude from human disturbance compared to past decades. Therefore the unit’s carrying capacity for mule deer has declined. The population objective that was set in 1995 is no longer achievable under the current habitat and land use conditions.

Recreation Impacts

Human disturbance from outdoor recreation is a major wildlife management concern as recreation activities have expanded in the Eagle Valley over the past decade (see “Outdoor Recreation” section). This heightened level of human activity on the landscape is a disturbance to deer, particularly during winter and fawning periods. Deer may react to a human by being vigilant, which reduces the amount of time they would otherwise be feeding; or by fleeing, which expends energy they would otherwise not have used and can cause

abandonment of fawns. Repetitive disturbance may result in abandonment of quality habitat for inferior locations. Whatever the reaction, deer incur an energetic cost. Cumulatively, these behavioral stressors can have population-level effects that result in a net effect of lower fawn recruitment and reduced population growth rate.

Seasonal closures to motorized and mechanized travel are in place each winter on BLM lands on East Eagle SRMA (except Bellyache Road and Pool and Ice Rink Trails remain open) from December 1 to April 15 and on Hardscrabble SRMA from January 16 to April 15. CPW has also instituted a spring closure on shed-antler hunting on public lands in this unit: it is unlawful to collect shed antlers on public lands from January 1 through April 30 at any time of day or night².

However, seasonal closures and similar restrictions are only as effective as they are complied with, enforced, and socially accepted. With limited BLM and CPW staff to patrol and enforce these regulations, it is admittedly difficult to ensure compliance with these closures. Many seasonal closure dates are compromises and do not extend far enough into spring to maximize herd health and welfare. Often when the lower elevations become snow-free, many recreationists are eager to hit the trails in the spring; however, deer, elk, and other wildlife still rely on these winter and transitional ranges where spring green-up is occurring and before their summer ranges are melted out. In the spring, when female deer are in the third trimester, transitional ranges become vital habitats for the does to gain the body fat necessary to produce viable healthy fawns and to be healthy enough to lactate. Likewise, in early winter when lower elevations are snow-free but upper elevations are under snow cover, most deer have migrated to winter range and need to conserve as much body fat as possible to last through the winter. It is important for recreationists to be aware of their potential impacts on wildlife, to follow the seasonal closure dates, and to encourage their peers to do so as well.

Habitat Loss and Fragmentation from Land Development

As detailed in the “Land Development/Real Estate” section above, substantial land development in the Eagle Valley has occurred in the past 30+ years, including on mule deer winter range areas on Bellyache Mountain and along the valley bottoms of Gypsum and Brush Creeks. Because of the high monetary value of land in the DAU, along with a decline in the livestock industry, there is great financial incentive for large ranches to subdivide and develop into residential housing. Conservation easements are difficult to secure because of the high cost of land. Notably, among the larger conservation easements within D-14 are Hardscrabble Ranch and Diamond S Ranch, both held by Eagle Valley Land Trust. With over one-third of mule deer winter range in D-14 being private lands, the need for conservation of existing habitat on private lands is high.

Habitat Condition

As discussed in the “Habitat Capability and Condition” section above, big game habitat condition on winter ranges has declined throughout the DAU. It appears that the causes of most range problems include: plant succession towards later seral stage or climax

² From 2015-2017, antler shed collection on public lands in GMU 44 and several surrounding units was prohibited from January 1 to March 14, and also from legal sunset to 10 A.M. from March 15 to May 15. In 2018, these dates were revised to Jan 1-April 30, and the units affected were revised to all GMUs west of I-25 (with additional timing restrictions for Gunnison Basin units).

communities, historic inappropriate livestock grazing, and localized excessive big game use (a possible result of loss of traditional winter ranges to development and over-populations of deer in the 1960s). Land development has limited the use of prescribed burns on the adjacent public lands because of concerns about the risk of fire damaging personal property.

Competing Herd Management Objectives: Buck Ratio and Population Growth

When managing simultaneously for population size and buck ratio, there can be tradeoffs. For example, deer populations managed for high buck ratios have been correlated with lower fawn ratios (Bergman et al. 2011). Adult bucks may be outcompeting fawns for forage and space, leading to lower fawn recruitment. Since 1995, the population size of D-14 has been 40 to 70% below objective, averaging 68% below objective since 2008 (see “Post-hunt Population Size” section above). Doe licenses have been highly limited throughout almost all years since 1995 to attempt to increase the population; yet the deer population size has not grown in response. The current fawn ratio (see “Fawn:Doe Ratio” section above) is only sufficient to maintain the population, but is not high enough to yield population growth. Meanwhile, the buck ratio has exceeded the current sex ratio objective for most of the past decade and is on an increasing trajectory (see “Buck:Doe Ratio” section above). At present, the buck ratio is 34% over the objective. The high buck ratio seen in D-14 could be contributing to the inability to increase the overall deer population.

Chronic Wasting Disease Status

Chronic Wasting Disease (CWD) is an infectious prion disease that affects cervids including mule deer. Deer infected with CWD usually die within 2 years of infection (Miller et al. 2012) and compared to uninfected deer, CWD-positive deer have both an overall higher mortality rate as well as a higher rate of being preyed upon by mountain lions (Miller et al. 2008). In herds that have a high prevalence rate of CWD, mortality due to CWD will eventually cause population declines (Miller and Fischer 2016). In addition, although there has not been evidence so far of transmission to humans, Miller and Fischer (2016) recommend a cautious approach of not consuming meat from CWD-positive animals. The CWD infection rate in mule deer bucks is about twice that of does (Miller and Conner 2005), so herds with high buck-to-doe ratios are more likely to have a higher CWD prevalence.

CPW has developed a Chronic Wasting Disease Response Plan with specific management guidelines to keep CWD prevalence in mule deer herds to <5% (CPW 2018). The CWD Response Plan outlines a 15-year monitoring plan in which certain selected herds will have mandatory testing of harvested bucks every 5 years. For herds that are not selected for the mandatory testing program, CWD surveillance will rely on voluntary testing of harvested deer and opportunistic testing of other dead deer (e.g., roadkills, winter- or predator-killed deer, or suspected CWD-symptomatic deer that are culled) (CPW 2018). Cost is the major factor limiting all herds from being tested. According to the CWD Response Plan, “when detections suggest prevalence is at a level of concern and increasing in a herd, it will be prioritized for mandatory testing” (CPW 2018).

In DAU D-14, the prevalence of CWD is not well known because few deer have been submitted for CWD-testing and it is not currently among the mandatory testing units. In the most recent 5-year sample (2014-2018), there were 7 bucks and 1 doe voluntarily submitted for testing. None of these 8 animals tested positive for CWD. However, if and when CWD appears in this herd, managing for a high buck ratio in D-14 could inadvertently facilitate the spread and prevalence of the disease.

If a herd's CWD prevalence reaches or exceeds 5%, the CWD Response Plan recommends the following harvest management actions (CPW 2018). CPW herd managers may take *any* or *all* of these actions in order to reduce CWD prevalence to below the 5% management threshold:

1. Reduce the population to the lower end of the objective range (increase overall harvest)
2. Reduce the buck:doe ratio to the lower end of the objective range (increase buck harvest)
3. Reduce the age structure (shift timing of buck harvest to later seasons to target older-age bucks)
4. Focus harvest in CWD hotspot locations

In addition, regardless of the CWD prevalence level within a herd, these routine practices should be followed (CPW 2018):

5. Avoid artificially concentrating deer via agricultural feed, salt, or mineral blocks
6. Use proper carcass disposal procedures to avoid spreading CWD via exposed carcasses

If these CWD management actions fail to reduce CWD prevalence in a herd to below the management threshold (5% prevalence) within 60 months (5 years), the Herd Management Plan update should be revised to lower the population and sex ratio objectives in order to reduce CWD prevalence to below 5% (CPW 2018). Furthermore, if CWD prevalence exceeds 10%, then a Herd Management Plan revision should be done within 12-18 months (CPW 2018).

PUBLIC INVOLVEMENT

In October-November 2017, we contacted 2,653 households in which one or more household members had either drawn a GMU 44 deer license or applied for a GMU 44 deer license as their first choice within the past 3 years (2014-2016). We mailed postcards to these households with a request to complete an online survey on D-14 deer management. There were 353 people who completed the online survey (13% response rate). Links to the complete survey results are available in Appendix B.

Key highlights of the hunter survey results:

- 58% have hunted deer in D14; 42% have not hunted deer (may have hunted other species in unit)
- Ranking of reasons to hunt deer in D14 (% rated as "very important"):
 1. To obtain a trophy buck (55%)
 2. To spend time in nature (54%)
 3. To contribute to wildlife management of deer (40%)
 4. To spend time with family/friends (39%)
 5. To obtain wild game meat (36%)
 6. To contribute economically to the local community (15%)
 7. To reduce property damage caused by deer (6%)
- Ranking of concerns about deer management in D14 (%rated as "Very Concerned"):
 1. Loss and fragmentation of deer habitat due to land development (69%)
 2. Difficulty of drawing a deer license (62%)
 3. Effects of predation on the deer population (56%)
 4. Inability to increase the deer population (55%)

5. Quality of bucks (52%)
 6. Disturbance and displacement of deer by non-hunting outdoor recreationists (49%)
 7. Declining quality of forage due to changes in plant communities & lack of natural wildfires (48%)
 8. Effects of hunting on the deer population (31%)
- Preferred population objective = Increase from the current population (58%)
 - Preferred buck ratio objective = maintain the current buck ratio (50%)
 - Common and/or notable comments:
 - Crowding from too many OTC (esp 3rd season) & 4th season elk hunters
 - Too many lions, bears, coyotes
 - Too many mountain bikers
 - Too many dirt bikers (including unauthorized off-trail use)
 - Too many hikers with dogs
 - Too many ATVs & vehicles
 - Not enough ATV access
 - Roadkilled deer
 - Keep as a trophy buck unit (more responses); vs. provide more buck hunting opportunities (several responses)
 - Preference point creep, some will use points elsewhere
 - Preference point thresholds for resident/non-resident allocation and for hybrid draw are based on 2007-2009 3-year average minimum preference points → why hasn't the 3-year average been updated?
 - Resident/Non-resident allocation - comments in both directions (i.e., give more to locals/residents vs give more to non-residents)
 - Antler point restrictions (e.g., 3-pt restriction)
 - Human growth, outdoor recreation, development impacts on winter range
 - Private land refuges
 - Not enough deer; Enough deer; Too many deer; Not enough quality bucks; Plenty of quality bucks; Deer pop is increasing; Deer pop is decreasing
 - Poaching
 - Offer "Management" buck tags as well as "Trophy"

Draft Plan public comment period, late September - October 2018

The draft herd management plan was opened for public comment from Sept 18 - Oct 31, 2018. The draft plan was posted on the CPW herd management plan website and also a media press release was sent out. We also held a public meeting for both the D14 and D53 herd management plans at the CPW office in Glenwood Springs and had 17 attendees.

A second online questionnaire was available for the public to comment on the proposed herd management objectives. Links to a summary of the 13 responses to the online questionnaire is attached in Appendix C.

Presentations were given to the Eagle Board of County Commissioners and the Lower Colorado River Habitat Partnership Program (HPP) committee; and BLM and USFS were also asked for comments. Written comments (if any) from these entities are attached in Appendix D.

MANAGEMENT ALTERNATIVES and PREFERRED OBJECTIVES

Proposed Population Objective

The current (2018) D-14 population estimate is approximately 2,070 deer and the current (1995 DAU plan) population objective is 7,000 deer. CPW is proposing a new population objective range of 1,500-3,500 deer. A range of population size for the objective allows for some annual variation in population size due to non-hunting related factors such as weather variability and due to the inexactness of population modeling methods (see “Overview of Procedures to Estimate Population Size” section above).

Only one population objective alternative is being proposed because it is the only reasonably achievable objective under current habitat and land use conditions. In the 23 years since the current objective was set, D-14 has never come close to achieving that population size and the past 10+ years of extremely conservative deer licenses have not resulted in any increase in population, so a higher population objective is not realistic within the next 10 years’ timeframe. A lower population objective is also not desirable or needed because there are no deer game damage problems or other deer-human conflict issues in D-14.

Under the proposed population objective, license numbers would either remain similar to current quotas or could be increased if weather and other environmental/habitat conditions are favorable for population growth and increased sustainable harvest. Because current quotas are already very low, further decreases in license quotas would have no effect on the population size.

Table 7. Proposed population objective for DAU D-14

Proposed Population Objective	
Alternative 1:	1,500-3,500 (midpoint 2,500)
Current (1995 DAU plan) population objective:	7,000 deer
Current (post-hunt 2018) population estimate :	2,070 deer

Sex Ratio Objective Alternatives

The most recent 3-year average (2014, 2015, 2018) observed sex ratio is 47 bucks per 100 does and the current objective is 35 bucks per 100 does. The three alternatives under consideration represent increasing degrees of buck quality, with the tradeoffs being increasing difficulty to draw a deer license, increasing risk of Chronic Wasting Disease (CWD) prevalence if the disease becomes established in the population, and decreasing resiliency of the herd to recover from severe weather events. The ranges within each alternative allow for annual variation in sex ratio that can occur naturally due to factors such as weather fluctuations and differential over-winter mortality rates of bucks and does.

Table 8. Proposed alternatives for D-14 sex ratio objective

Proposed Sex Ratio Objective	
Alternative 1:	30-40 (midpoint 35)
Alternative 2:	35-45 (midpoint 40)
Alternative 3:	40-50 (midpoint 45)
Current (1995 DAU plan) Sex Ratio Objective:	35 bucks per 100 does
Most recent (post-hunt 2014, 2015, 2018) 3-year average sex ratio:	47 bucks per 100 does

Under Alternative 1 (30-40 bucks per 100 does), the sex ratio would need to be reduced by -15% to -36% from the current 3-year average. The quality of bucks in the herd would be average to moderately above-average (herds with ratios around 30 bucks per 100 does are managed more for hunting opportunity; at 40 bucks per 100 does, herds are generally managed for decent quality). Buck license quotas would be increased, so there would be more chances for hunters to draw a tag. However, hunter crowding on public lands would likely be higher than in the past. At a lower buck-to-doe ratio, there would be relatively fewer bucks competing with fawns and does for forage and space, so fawn recruitment and population growth rate are likely to improve. Assuming that the older bucks tend to preferentially selected for harvest by hunters, the age structure of the buck segment of the deer herd would become younger. Among the alternatives under consideration, the chances of CWD prevalence should be less with lower buck ratios.

Under Alternative 2 (35-45 bucks per 100 does), the sex ratio would need to be reduced by -4% to -26% from the current 3-year average. Bucks in the population would be moderately high quality. Buck license quotas would increase slightly. There would be more opportunities to hunt bucks, hunter crowding may increase somewhat, and fawn recruitment and population growth may improve. The age structure of bucks in the herd and the likelihood of CWD transmission would be intermediate to that of Alternatives 1 and 3.

Under Alternative 3 (40-50 bucks per 100 does), the sex ratio could be within -15% to +6% from its current 3-year average. At this range of buck ratio, the quality of bucks would remain moderately high to very high quality, but population growth rate may be slower than under Alternatives 1 and 2 due to having relatively more bucks in the population competing with fawns and does. Older bucks might not survive a hard winter and it could take longer to recover to a higher buck ratio objective. At these high buck ratios, CWD (if present in the herd) could spread more readily due to higher prevalence rates in bucks than in does. CWD mortality could lead to further population declines. Buck license quotas would remain similar to current levels or may be increased slightly, but the chances of drawing a buck tag would still be low. Hunter crowding on public lands would likely be similar to present conditions.

Preferred Alternatives and New Objectives

Preferred post-hunt population objective range = 1,500 to 3,500 deer.

As addressed above, a wide objective range of 1,500 to 3,500 deer allows for more flexibility in harvest management of D-14 to account for environmental variability. Objectives below or above this proposed objective range are neither realistic for this herd, nor desirable.

Preferred post-hunt sex ratio objective range = 35-45 bucks per 100 does (Alternative 2).

Alternative 2 is the CPW staff-preferred alternative because it would continue to provide high quality buck hunting in the unit, but not be too high to pose problems with the health of the herd and its ability to recover from weather events or be resilient against disease outbreaks and other stressors.

STRATEGIES TO ADDRESS ISSUES AND MANAGEMENT CONCERNS

Few of the issues and management concerns identified in this management plan are wholly within CPW's regulatory purview. Addressing many of the issues and management concerns requires close coordination with other federal, state, and local governmental entities and other organizations. CPW will continue to work collaboratively with our partners in the federal land management agencies, private landowners, county governments, local municipalities and NGOs to protect and enhance the remaining mule deer habitat. Important habitat conservation methods include habitat treatments, conservation easements or land acquisitions, maintaining landscape connectivity and movement corridors, and adhering to seasonal recreation closures on winter range areas.

STRATEGIES TO ACHIEVE HERD MANAGEMENT OBJECTIVES

To achieve the new objectives of a population size of 1,500-3,500 deer and a sex ratio of 35-45 bucks per 100 does over the next 10 years, CPW will continue to set licenses annually, keeping in mind such issues as Chronic Wasting Disease and achieving a balance between maintaining high quality bucks and providing some additional opportunity for hunters to draw buck licenses in the high-demand seasons.

ACKNOWLEDGEMENTS

Thanks to Michelle Flenner (GIS specialist, CPW) for conducting spatial analyses and preparing the maps for this document.

LITERATURE CITED

- Bartmann, R.M., White, G.C., and Carpenter, L.H. 1992. Compensatory mortality in a Colorado mule deer population. *Wildlife Monographs* No. 121. 39 pp.
- Bergman, E.J., B.E. Watkins, C.J. Bishop, P.M. Lukacs, and M. Lloyd. 2011. Biological and Socio-Economic Effects of Statewide Limitation of Deer Licenses in Colorado. *Journal of Wildlife Management* 75:1443-1452.
- Bishop, C.J., White, G.C., Freddy, D.J., Watkins, B.E., and Stephenson, T.R. 2009. Effect of enhanced nutrition on mule deer population rate of change. *Wildlife Monographs* No. 172. 28 pp.
- Bureau of Land Management (BLM). 2015. Colorado River Valley Field Office Record of Decision and Approved Resource Management Plan. BLM/CO/GI-15/003.
- Chapman, S. S., Griffith, G. E., Omernik, J. M., Price, A. B., Freeouf, J., and Schrupp, D. L. 2006. Ecoregions of Colorado (color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia, U.S. Geological Survey (map scale 1:1,200,000).
- Colorado Parks and Wildlife (CPW). 2018. Colorado Chronic Wasting Disease Response Plan. 41 pp.
- Homer, C.G., Dewitz, J.A., Yang, L., Jin, S., Danielson, P., Xian, G., Coulston, J., Herold, N.D., Wickham, J.D., and Megown, K., 2015, [Completion of the 2011 National Land Cover Database for the conterminous United States-Representing a decade of land cover change information](#). *Photogrammetric Engineering and Remote Sensing*, v. 81, no. 5, p. 345-354
- Johnson, H. E., J. R. Sushinsky, A. Holland, E. J. Bergman, T. Balzer, J. Garner, and S. E. Reed. 2017. Increases in residential and energy development are associated with reductions in recruitment for a large ungulate. *Global Change Biology* 23:578-59.
- Miller, M.W. and M.M. Conner. 2005. Epidemiology of chronic wasting disease in free-ranging mule deer: spatial, temporal, and demographic influences on observed prevalence patterns. *Journal of Wildlife Diseases* 41: 275-290.
- Miller, M. W., H. M. Swanson, L. L. Wolfe, F. G. Quartarone, S. L. Huwer, C. H. Southwick, and P. M. Lukacs. 2008. Lions and prions and deer demise. *PLoS ONE* 3(12): e4019.
- Miller, M.W., Wolfe, L.L., Sirochman, T.M., Sirochman, M.A., Jewell, J.E., Williams, E.S. 2012. Survival patterns in white-tailed and mule deer after oral inoculation with a standardized, conspecific prion dose. *Journal of Wildlife Diseases* 48: 526-529.
- Miller, M. W., and J. R. Fischer. 2016. The first five (or more) decades of chronic wasting disease: Lessons for the five decades to come. *Transactions of the North American Wildlife and Natural Resources Conference* 81:1-12.

Sushinsky, J. R., H. E. Johnson, A. Holland, T. Balzer, J. Garner, and S. E. Reed. 2014. Quantifying Land-Use and Land-Cover Change in Mule Deer Habitat. Technical Report to Colorado Parks and Wildlife. Wildlife Conservation Society, North America Program, Bozeman, MT.

Unsworth, J.W., D.F. Pac, G.C. White, and R.M. Bartmann. 1999. Mule Deer Survival in Colorado, Idaho, and Montana. *Journal of Wildlife Management* 63:315-326.

United States Forest Service (USFS). 2012. White River National Forest Travel Management Implementation Plan 2011-2015. USDA Forest Service, Region 2.
https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5365835.pdf

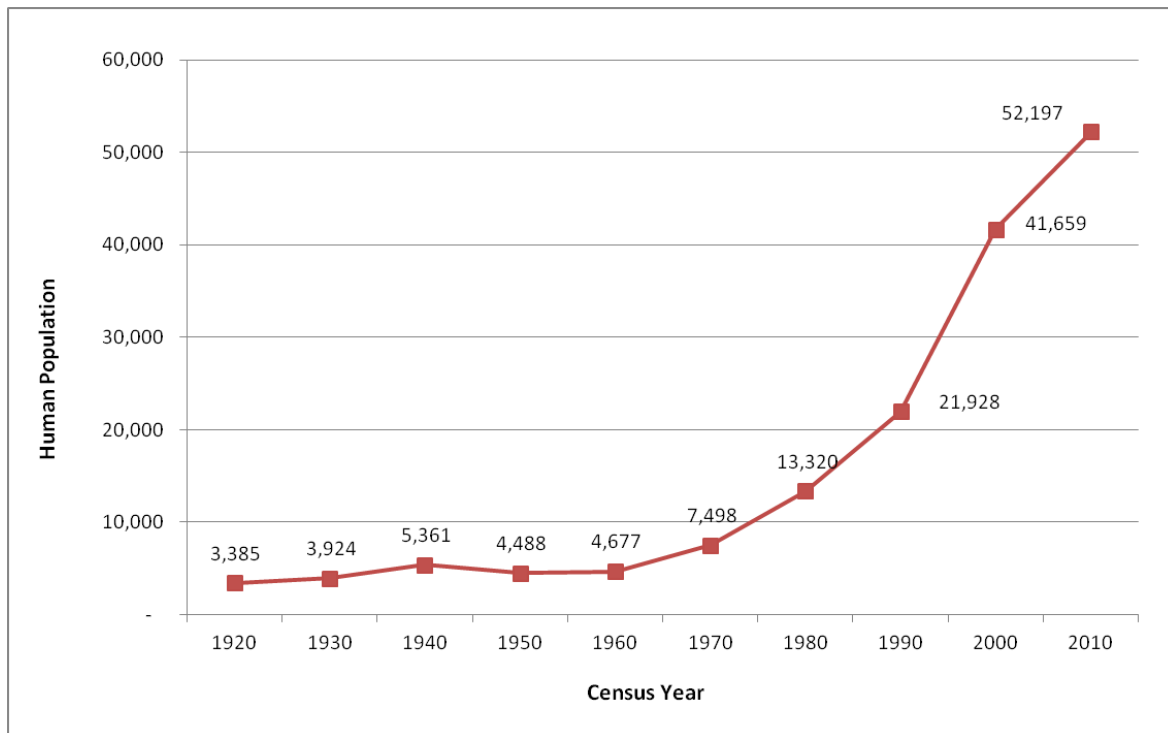
White, G. C., and B. C. Lubow. 2002. Fitting population models to multiple sources of observed data. *Journal of Wildlife Management* 66:300-309.

Draft

APPENDICES

Appendix A. Human population in Eagle County, Colorado, 1920-2010.

Source: U.S. Census Bureau



Appendix B. Results of online hunter questionnaire, Oct-Nov 2017.

To view the complete results of the D14 hunter survey, go to either of the following links:
https://drive.google.com/file/d/1WFdfuJusw8_e_dhE8MQ-w5qNfp_ZlVxx/view?usp=sharing

or

<https://tinyurl.com/y8to544h>

Appendix C. Results of public comment period questionnaire, Oct 2018.

To view the complete results of the D14 public comment period questionnaire, go to either of the following links:

https://drive.google.com/file/d/1BTJQLtnvZ7bsGer7VSMa2y_vxD8tcp3/view?usp=sharing

or

<https://tinyurl.com/y8s7qkdl>

Appendix D. Comment letters from other agencies and committees.



October 25, 2018

Julie Mao
Colorado Parks and Wildlife
0088 Wildlife Way
Glenwood Springs, CO 81601

RE: Lower Colorado River Habitat Partnership Program Comments - Deer DAU D-14

Dear Julie:

One of the initial reasons for creating the Habitat Partnership Program was to provide local landowners and other interests an opportunity to provide input into big game management in their areas. The diverse makeup of local HPP committees (3 livestock growers plus a Forest Service, BLM, CPW and sportspersons representative) provide a good cross section of local interests to review DAU proposals and respond accordingly for CPW consideration.

The Lower Colorado River HPP committee has discussed your presentation and reviewed the draft alternatives for this DAU plan update. The Lower Colorado River HPP committee is in agreement with the following comments pertaining to proposals for the population range and sex ratio objectives for the above DAU plan.

The LCRHPP committee supports the draft alternative 1, to decrease the proposed population range within this DAU and within our committee area. The LCRHPP has heard from landowners and land managers about poor range conditions on both public and private lands. While many factors play into these conditions, reducing the number of big game animals is one step that would help to improve range conditions and forage resources.

The LCRHPP committee also discussed the proposed sex ratio and agreed with alternative 2. We support lowering the current sex ratio objective to a range that, while still maintaining larger bucks, would ultimately increase the opportunity for more hunters in the field.

Thank you for the presentation and the opportunity to provide these comments.

Sincerely,

Darren Chacon, Co-Chair
Lower Colorado River HPP Committee