



COLORADO BIG GAME ACTION PLAN

For

Implementation of Department of the Interior Secretarial Order 3362: Improving Habitat Quality in Western Big-Game Winter Range and Migration Corridors

October 2024

Executive Summary

Colorado Parks and Wildlife (CPW) has identified five landscape priority areas that will guide efforts by the agency and its partners to implement Department of the Interior (DOI) Secretarial Order 3362 (SO 3362) and conserve big game winter range and migration corridors.

Landscape Priority Areas

For Colorado's 2023 Action Plan, we have retained the five mule deer and elk landscape priority areas that were identified in the 2022 action plan. These areas include the Bears Ears/White River in northwest Colorado, the San Juan Basin in southwest Colorado, the Uncompahgre Plateau in southwest Colorado, the Piney River/State Bridge area in north central Colorado and the Book Cliffs area in west-central Colorado (Figure 1).

The Bears Ears/White River mule deer and elk herds are among the largest herds in Colorado, however the severe winter conditions in 2022-23 heavily impacted herds located in the northwest portion of the state. Recovery from this winter event will take time. The 2023 winter population estimates for these herds are approximately 38,000 deer and 41,000 elk. Prior to winter 2022-23, the elk herds were within the Herd Management Plan (HMP) population objectives. The projected 2024 winter population estimates show the elk herds still below population objective levels. The mule deer herds were already in decline prior to the severe winter and remain below population objective ranges. The White River mule deer herd is one of five herds in a long-term survival monitoring study. The survival study will be expanded to the White River elk herd in 2025. Current GPS-collar location fixes are set at two locations per day to prolong collar longevity and reduce project costs. Increasing the number of location fixes obtained per day would provide finer scale migration location data to benefit the mapping of migration corridors, identification of

physical barriers to movement, identification of pinch points, improve habitat quality assessment of migration corridors or transition range and may help determine thresholds for levels of disturbance and fragmentation for big game populations.

Also, strategically placed habitat treatments, conservation easements, and highway crossing structures will be critical to conserve the migration corridors and winter range used by these important herds. In addition, this area supports the largest greater sage-grouse population in the state.

The San Juan Basin provides habitat for approximately 24,000 mule deer and 21,000 elk, which use various migration routes as they travel across a patchwork of federal, tribal, state and privately-held lands. A portion of these animals migrate south onto Southern Ute Tribal (SUIT) lands and/or across the state boundary into New Mexico during winter months. The San Juan priority landscape has several highway segments identified by the Colorado Department of Transportation for wildlife crossing infrastructure. The region's big game herds will benefit from strategically placed habitat treatment projects, conservation easements, and highway crossing structures.

The Uncompahgre Plateau historically supported as many as 60,000 mule deer, the 2023 winter population estimates are estimated at only 11,200 mule deer, along with 12,700 elk. Deer have declined more drastically in recent years due to poor fawn recruitment rates, which in turn could be attributed to persistent drought, poor habitat condition, forage competition, disease, human development, increasing recreational impacts, and predation. The Uncompahgre Plateau mule deer herd is one of five herds in a long-term survival monitoring study. Current GPS-collar location fixes are set at two locations per day to prolong collar longevity and project costs. Increasing the number of location fixes obtained per day would provide finer scale migration location data to benefit the mapping of migration corridors, identification of physical barriers to movement, identification of pinch points, improve habitat quality assessment of migration corridors or transition range and may help determine thresholds for levels of disturbance and fragmentation for big game populations. In addition, migration corridors and winter range can be enhanced through projects that incorporate conservation easements, wildlife-friendly fencing, travel management on USFS and BLM lands, habitat improvements and highway crossing structures.

The Piney River/State Bridge area, which serves as big game winter range habitat for 13,100 deer and 3,800 elk, has declined in quantity and quality due to land development, fragmentation by roads and trails, increased human activity on public lands, long-term drought and suppression of large-scale wildfires. A new GPS-collaring project to better characterize seasonal ranges, movements, and habitat selection by elk and deer will begin in winter 2024-2025. The priority landscape would benefit from conservation easements to protect migration corridors and winter ranges, as well as limited recreational activity on

winter range. Strategically placed highway crossing structures are also needed to conserve and restore connectivity for migrating wildlife. Well-designed and strategically placed habitat treatment projects are recommended to improve the forage quality and capacity of winter range within this area. These projects also benefit greater sage-grouse and Columbian sharp-tailed grouse, which occur in small numbers within this area.

The Book Cliffs area supports about 8,300 mule deer and 6,000 elk. Both deer and elk migrate in elevation with the seasons. Portions of each herd migrate relatively long distances west, crossing state lines to spend the winter months in Utah. BLM lands are important winter range for both species; thus CPW collaborates with BLM to support efforts to minimize and mitigate the negative effects of developments and recreational activities on migrating big game. The protection of private lands is also an important conservation action within migration corridors and winter range through conservation easements, and strategically identifying habitat enhancement projects to counteract the effects of livestock grazing and improve forage quality for wintering deer and elk.

Table of Contents

| | |
|---|----|
| <u>Introduction</u> | 5 |
| <u>Landscape Priority Areas</u> | 7 |
| <u>#1 Colorado Landscape Priority Area: Bears Ears & White River (Northwest Colorado)</u> | 13 |
| <u>#2 Colorado Landscape Priority Area: San Juan Basin (Southwest Colorado)</u> | 24 |
| <u>#3 Colorado Landscape Priority Area: Uncompahgre Plateau (West-Central Colorado)</u> | 30 |
| <u>#4 Colorado Landscape Priority Area: Piney River/State Bridge (Northwest Colorado)</u> | 38 |
| <u>#5 Colorado Landscape Priority Area: Book Cliffs (West-Central Colorado)</u> | 47 |
| <u>Appendix A: Department of the Interior Secretarial Order 3362: Improving Habitat Quality in Western Big-Game Winter Range and Migration Corridors</u> | 55 |
| <u>Appendix B: Examining the Timing, Extent, and Distribution of Mule Deer Migration in the North Park Deer Herd, Colorado, USA</u> | 61 |

Introduction

Secretarial Order 3362 (SO 3362 - Appendix A) directs appropriate bureaus (US Fish and Wildlife Service (USFWS), National Park Service (NPS), and Bureau of Land Management (BLM)) within the Department of the Interior (DOI) to work in close partnership with the State of Colorado to enhance and improve the quality of big-game winter range and migration corridor habitat on federal lands under the jurisdiction of the DOI in a way that recognizes state authority to conserve and manage big-game species and respects private property rights. Through scientific endeavors and land management actions, wildlife such as Rocky Mountain elk (elk), mule deer, pronghorn antelope (pronghorn), and a host of other species will benefit.

Deer and elk need the ability to move between important summer and winter ranges using connected and permeable migration habitat. The largest and most productive deer populations in the West are migratory. Development and barriers that disrupt migration can have a direct bearing on an individual animal's health, survival and reproductive success. Conditions in the broader landscape may influence the function of migration corridors and sustainability of big game populations. Such conditions may include habitat fragmentation, land use patterns, resource management, or urbanization. The United States Department of Agriculture (USDA), through the USDA Forest Service (USFS) and USDA Natural Resource Conservation Service (NRCS), will collaborate with DOI, the states, and other natural resource managers across the broader landscape when developing an all-lands approach to research, planning, and management for ecological resources, to include migration corridors, in a manner that promotes the welfare and populations of elk, deer, and pronghorn, as well as the ecological integrity of terrestrial ecosystems in the plan area.

Similarly to SO 3362, Colorado Executive Order D 2019 011, *Conserving and Restoring Colorado's Big Game Winter Range and Migration Corridors*¹ (EO), issued by Governor Jared Polis in 2019, elevated the state's priority to conserve sensitive habitat and connectivity for mule deer, elk and pronghorn, as well as bighorn sheep. A status report, *Big Game Winter Range and Migration Corridors*², completed in 2020 by Colorado Parks and Wildlife (CPW) in response to a directive in the EO outlines recommended conservation actions associated with specific threats to Colorado's big game populations, many of which involve coordination with federal land management agencies and other partners. These threats include: development pressures associated with human population growth; increased recreation and visitation; climate-influenced drought, catastrophic events, and habitat alteration; loss of native vegetation; energy and mineral development; forage competition with feral and domestic livestock; and transportation conflicts. Also, in response to the EO,

¹ Colorado Parks and Wildlife Commission (PWC), Resolution 19-01, Regarding Support for Governor Polis' executive Order D 2019-011: Conserving Colorado's Big Game Winter Ranges and Migration Corridors (November 15, 2019).

² Cooley C.P., et al. 2020. Colorado Parks and Wildlife, *Status Report: Big Game Winter Range and Migration Corridors*.

the Colorado Department of Natural Resources (DNR) with other contributors published a policy report in 2021, *Opportunities to Improve Sensitive Habitat and Movement Route Connectivity for Colorado's Big Game Species*.³ The goal of this report was to identify, evaluate, and recommend priorities for a range of regulatory, policy, and legislative approaches to ensure the health of Colorado's big game herds.

CPW is currently developing a Statewide Habitat Conservation and Connectivity Plan as identified in the *Opportunities to Improve Sensitive Habitat and Movement Route Connectivity for Colorado's Big Game Species* report³. The plan utilizes selected wildlife species, landscape disturbance, and movement corridors to identify priority areas and to provide strategic guidance to conserve, enhance and connect these landscapes. The plan will provide a comprehensive, coordinated and strategic approach to large-scale habitat management and protection to benefit many internal CPW programs and help communicate those priority areas and actions to conservation partners. CPW is currently in the process of finalizing the first phase of the plan to select priority areas. In early 2025 CPW will coordinate with staff and conservation partners to develop habitat and land conservation projects with the selected priority areas.

In addition, CPW developed the *Colorado West Slope Mule Deer Strategy*⁴ (WSMDS) report in 2014 that identified a list of issues affecting mule deer populations in Colorado. Those issues included: habitat quality, habitat quantity, predation, weather, highway mortality, disease, competition with elk, recreation impacts, barriers to movement, and hunting demands on doe harvest. Habitat quality and quantity issues are further subdivided into poor forage conditions, large-scale type conversion of habitat, loss of habitat to oil and gas and other energy development, and residential expansion.

The recently completed CPW migration monitoring study⁵ (Appendix B) of the North Park (D-3) mule deer herd was funded through the SO 3362 2018-2019 research funding opportunity. The study aimed to collect more information on mule deer movements using GPS-collars with fix rates ranging from 1-4 hours to examine migration characteristics. From previous collaring studies conducted in Colorado and Wyoming, it was known that many deer migrated bi-directionally out of North Park, either north to Wyoming or south to Middle Park, Colorado. Adult female mule deer were monitored from 2021 through 2023 to quantify the timing and duration of migration, distance and direction of travel, and delineate migration corridors and stopover areas. This information may aid CPW staff in assessing the efficacy of current management practices and to identify and conserve critical mule deer habitat. Additionally, such information may assist wildlife managers in

³ Colorado Department of Natural Resources and Colorado Department of Transportation. 2021. *Opportunities to Improve Sensitive Habitat and Movement Route Connectivity for Colorado's Big Game Species*.

⁴ Colorado Parks and Wildlife. 2014. *Colorado West Slope Mule Deer Strategy*.

⁵ VanNatta, Eric. 2024. *Examining the timing, extent and distribution of Mule Deer Migration in the North Park Deer Herd*, Colorado, USA.

assessing the reliability of population estimates, directing management for reducing Chronic Wasting Disease (CWD) prevalence, and identifying roadways at higher risk for deer-vehicle collisions. Data from this study may also serve as a more robust baseline for future assessments of North Park mule deer migration.

Colorado has approximately 66,387,200 total acres, 23,541,190 or 35% of which are owned by the federal government. The BLM manages 8,354,660 acres, the USFS manages 14,509,180 acres and the NPS manages 596,700 acres. Other agencies manage the rest of federal ownership. The State of Colorado owns approximately 2,917,700 acres. There are also millions of acres of privately owned parcels throughout big game habitat. This ownership structure requires cooperative partnerships to work effectively across all the habitat categories and ownerships for big game species.

Landscape Priority Areas

CPW continues to identify five landscape priority areas in the state for elk and mule deer herds in 2024. These include the Bears Ears/White River herds in northwest Colorado, San Juan Basin herds in southwest Colorado, the Uncompahgre Plateau in southwest, Piney River/State Bridge herds in north-central Colorado and the Book Cliffs herd in west-central Colorado (Figure 1). Two of the areas (Bears Ears/White River and Uncompahgre) have been part of an extensive deer survival study (VHF and GPS collars) for over 20 years. An elk survival monitoring study will be added to the White River elk herd in 2025. A more recent elk research study led by CPW Research Unit is on-going in the Bears Ears landscape. Deer and elk collaring studies were conducted by CPW, the Southern Ute Indian Tribe (SUIT)⁶, and WEST, Inc⁷ for the San Juan Basin elk and deer herds, while the Book Cliffs deer herd has only had limited GPS collars deployed. No collaring projects have occurred in the Piney River/State Bridge mule deer or elk herds, although there are two collaring studies planned to characterize seasonal ranges, movements, and habitat selection by elk and deer, starting winter 2024-2025.

These priority landscapes and their respective GPS movement data represent a partial sampling effort and should not be considered a complete census of animal habitat use or movement areas. Managers continue to work with stakeholders and agency personnel to identify related research and proactive conservation actions directed toward conserving vital habitats in these five priority landscapes.

⁶ Johnson, A. 2022. East Side Elk Study Final Report. Southern Ute Indian Tribe, Ignacio, CO.

⁷ Sawyer, H. 2018. Rosa Mule Deer Study - Final Report. Western Ecosystems Technology, Inc., Laramie, WY.

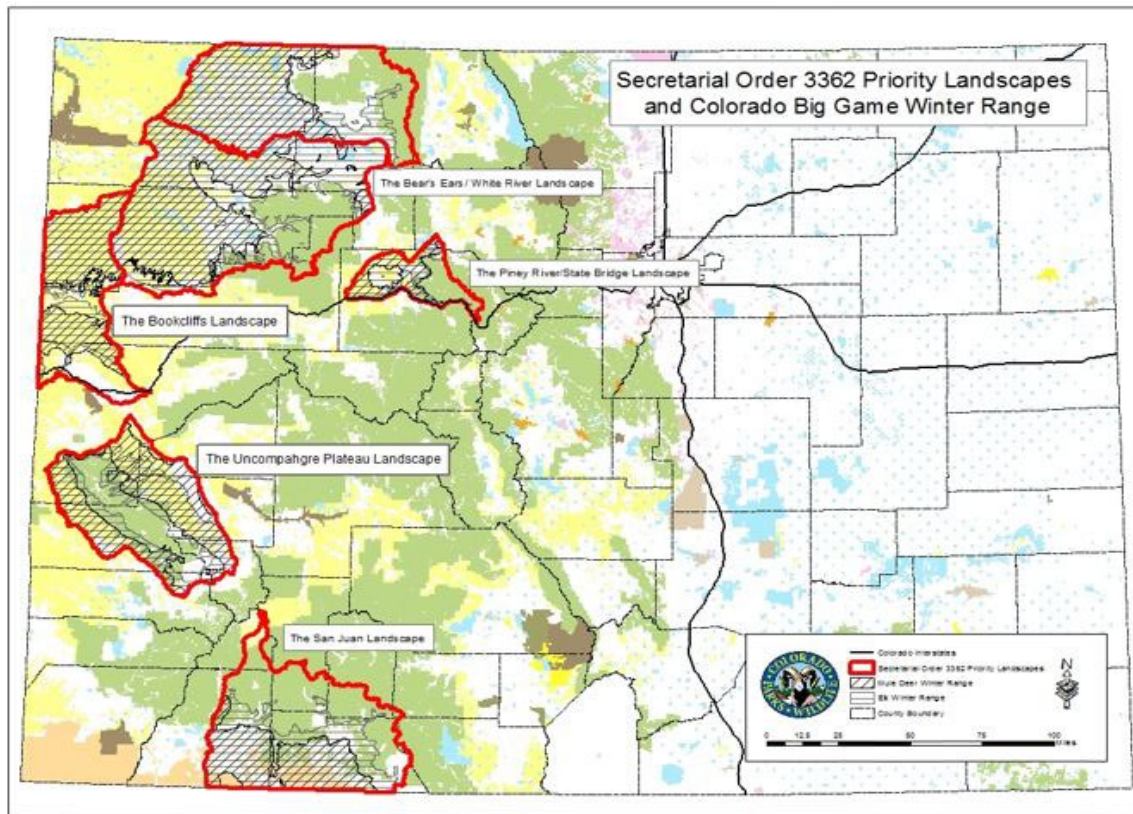


Figure 1. SO3362 Priority Colorado landscapes with mule deer and elk winter range and surface landownership.

During the winter of 2022-23 the northwest corner of Colorado experienced a historic winter event in both severity and duration that it has not been recorded in over 70 years. The severe winter zone extends from Steamboat Springs west to Rangely and north to the state line with Wyoming (Figure 2), this area holds large populations of mule deer, elk and pronghorn. The winter conditions surpassed the historic 1983-1984 winter in terms of persistent snowpack, lower temperatures and winds. Winter range forage was completely blanketed in hard-pack snow making it extremely challenging if not impossible for mule deer, elk and pronghorn to access food, thereby forcing thousands of animals to migrate farther west (Figure 3). Many of these animals succumbed to the elements and starvation, the full impact to ungulate populations in the severe winter zone will not be known for several years. Other areas of the Western Slope also experienced above average winter severity but not at the same magnitude as within the severe winter zone.

The 2023 statewide winter population estimate for mule deer of 376,000 deer is well below the population objective range of 438,000-520,000. In 2023, 18 of 54 (33%) mule deer herds were below their population objective ranges. These declines have occurred primarily in the largest, westernmost herds in the state. Examples include over a 40% reduction in the

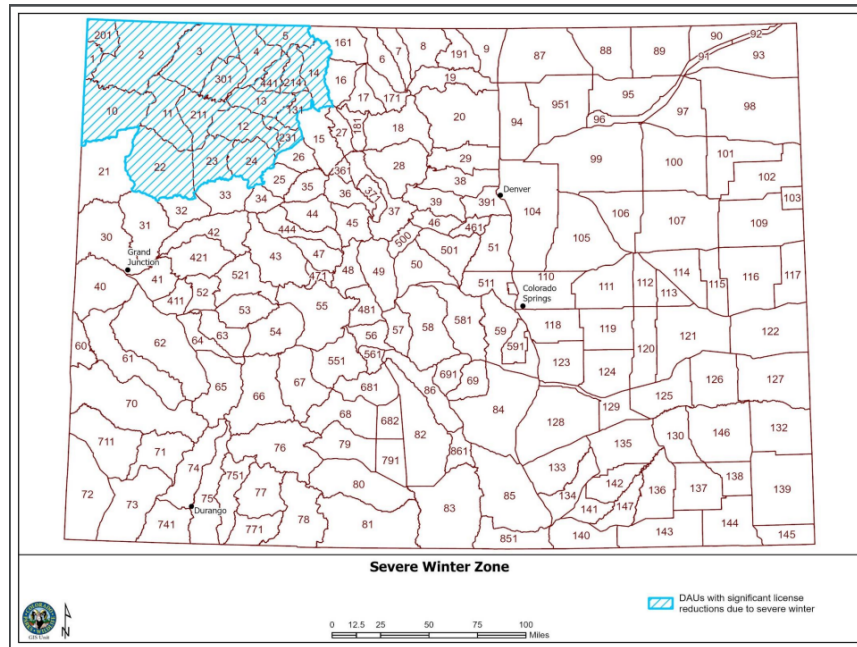


Figure 2. Severe winter zone identified by CPW following the historic conditions of the 2022-23 winter.



Figure 3. Photo of extreme snow conditions within the severe winter zone in early February 2023.

size of the White River herd (D-7), once the nation's largest, went from over 66,000 in 2005 to an estimated 38,000 in 2023. In addition, the Uncompahgre herd (D-19), once one of the largest deer herds in Colorado, has declined from approximately 60,000 deer in the 1980s to only about 11,200 mule deer in 2023. Western Colorado has historically supported some of the largest mule deer herds in the state and across the western United States, such that these declines are of both statewide and regional significance. CPW reduced hunter

license numbers in many deer herds due to herds at or below population objectives and severe localized winter conditions. The 2023 winter population estimate for elk of 303,000 remains within the population objective range of 259,600 – 317,300. In response to herds achieving population objectives through harvest management, declining calf ratios and concerns about crowding in archery season, CPW has reduced the overall number of elk hunting license numbers in many herds.

Projected human population growth and increased tourism heightens the impact of these threats. Threats from increasing human populations include the development and fragmentation of habitat, disturbance and displacement of wildlife due to greater year-round recreational activity, greater wildlife-vehicle conflicts related to increasing road density and vehicle traffic, and degradation of habitat from invasive plants and wildfires. Housing development is expanding into rural areas that were once large, intact working ranches in valuable winter range, while areas considered summer range, fawning/calving habitat and migration corridors are seeing increased pressures as demand grows surrounding higher elevation resort communities.

CPW initiated the Colorado's Wildlife Habitat Program (CWHP) in 2006. CWHP is an incentive-based, voluntary program that accomplishes strategic wildlife conservation goals and/or public access goals using conservation easements, public access easements and in some cases fee title purchases. From the program's inception in 2006 through 2022, CPW has invested approximately \$189,200,000 across Colorado to secure 291,000 acres in conservation easements, 146,800 acres in public access, and 33,000 acres in fee title purchase. CWHP funding comes from Habitat Stamp fees, Great Outdoors Colorado and occasionally from federal funding sources. The Habitat Stamp fee is a \$10 fee charged to a Colorado hunting or fishing license purchased by sportspeople 18-64 years of age. The interest in CWHP from private landowners continually exceeds funding resources available for land protection.

In addition, habitat is being fragmented, degraded and lost due to various forms of energy development. Development of rich natural resources such as oil shale and natural gas impacts vital big game winter ranges as these resources are typically found under rangeland habitat. Infrastructure and human activities associated with oil and gas development, including roads and railroads, also fragment, disturb or alter habitats including migration routes and movement corridors for big game. While impacts from renewable development are still being assessed, it is worth noting that the same landscape characteristics that often make sites suitable for solar facility siting, in particular (e.g., flat, unforested areas with southern exposures), contribute to landscape functionality as winter habitat and movement routes for big game species. Due to current federal requirements for security fencing to protect solar infrastructure, the installation of large-scale solar projects typically result in a complete loss of habitat for big game and other wildlife

species, and can preclude occupancy, movement and habitat restoration efforts for decades.

Concerns of noxious weeds establishing within native rangeland habitats have long been a priority for restoration by CPW. With climate change impacts and the increase in frequency and size of wildland fires this threat has expanded over the last decade. Cheatgrass and other noxious weed invasion into sagebrush habitats threaten the quality of wildlife habitat including winter range forage.

Many of Colorado's major roadways are in low-lying areas (such as canyon and river bottoms) that are important big game winter range and movement corridors. The network of roads built across Colorado causes direct and indirect habitat loss and fragmentation that create temporary or permanent movement barriers to wildlife species that attempt to cross in order to access food and habitat resources or for breeding and dispersal needs. Wildlife-vehicle collisions can have detrimental consequences to both humans and wildlife when animals attempt to cross roadways. Recently, Colorado Department of Transportation (CDOT) and CPW co-funded two studies to identify priority road segments (top 5%) most in need of future mitigation to reduce wildlife-vehicle conflicts. The West Slope Wildlife Prioritization Study (WSWPS)⁸ and the East Slope and Plains Wildlife Prioritization Study (ESPWPS)⁹ identified 185 miles on 48 road segments and 289 miles on 93 road segments, respectively. CPW and CDOT with other conservation partners have established the Colorado Wildlife Transportation Alliance to coordinate efforts to reduce wildlife-vehicle collisions and to increase permeability across Colorado's highways.

To help assess future impacts and conservation activities, CPW conducted its first comprehensive migration and range analysis of ungulate GPS-collar data in 2022.¹⁰ Over 4.9 million GPS-collar data points for mule deer, elk, pronghorn and bighorn sheep were compiled for the Brownian bridge migration movement (BBMM) analysis. From this analysis an overall migration range and concentrated-use migration corridors were identified. CPW defines migration range as an area suitable for use by migrating animals to move between seasonal ranges, regardless of the number of individuals. CPW defines a migration corridor as a specific geographic area that facilitates movement between seasonal ranges and receives higher use than the surrounding landscape, relative to herd or population use, and loss of which would disrupt migration. When a BBMM analysis is available for a given herd, low-use areas are mapped as migration range and areas of concentrated use are mapped as a migration corridor.

⁷ Kintsch, J., P. Basting, M. McClure and J.O. Clarke. 2019. Western Slope Wildlife Prioritization Study. Report to Applied Innovation and Research Branch Colorado Department of Transportation, Denver, CO.

⁸ Kintsch, J., P. Basting, T. Smithson and G. Woolley. 2022. CDOT-2022003: Eastern Slope and Plains Wildlife Prioritization Study, Colorado Dept. of Transportation.

¹⁰ Beaupre, C. 2022. Animal Sample Size Guidelines for Mapping Migrations and Distribution with GPS Collars [Unpublished bachelor's these]. Western Colorado State University, Gunnison, Colorado.

The majority of the GPS-collar locations were obtained from the five long-term mule deer survival study areas (Gunnison Basin, Middle Park, South Park, Uncompahgre and White River, Figure 4) that have been implemented since the late 1990's or early 2000's.¹¹ CPW is expanding the survival monitoring studies to include elk in the Disappointment Creek, Gunnison Basin, Middle Park, South Park and White River herds. The primary purpose of the survival studies are to determine survival rates for juveniles and adults, and identify cause-specific mortality factors. The GPS-collar locations data obtained has also been used to map seasonal ranges and migration corridors. To increase collar longevity and decrease project costs associated with these long-term studies, the location fixes per day are set to 2 per day or a 12 – 13 hour fix rate. Although a BBMM analysis for migration corridors can be conducted with a low fix rate, a more robust migration analysis would benefit from locations obtained at a higher fix rate.

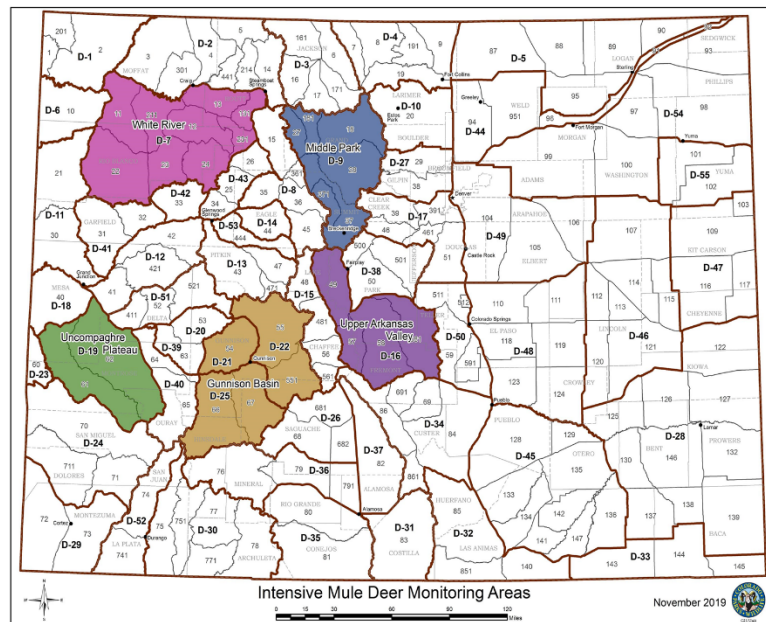


Figure 4. Colorado's five survival mule deer survival monitoring study areas.

Since GPS-collaring studies are limited in the state, the mapped BBMM migration corridor data is combined with other available data and staff expert knowledge and observations to form the CPW Species Activity Map (SAM) migration corridor data layers. CPW started mapping the SAM data as early as the mid-1970's using staff knowledge, collar locations and survey data. Combining data and information from all available sources allows for the use of the best available information to create a statewide migration corridor layer by species.

¹¹ Cooley C.P., et al. 2020. Colorado Parks and Wildlife, *Status Report: Big Game Winter Range and Migration Corridors*.

#1 Colorado Landscape Priority Area: Bears Ears & White River (Northwest Colorado)

The northwest corner of Colorado is home to two of the largest migratory mule deer and elk herds in Colorado and the western United States. The Bears Ears and White River priority landscape encompasses all of the mule deer Data Analysis Units (DAU) D-2 (Bears Ears) and D-7 (White River) and elk DAU E-2 (Bears Ears), and contains a significant portion of E-6 (White River) and a small portion E-10 (Yellow Creek) (Figure 1.1). The Bears Ears DAU is subdivided into seven Big Game Management Units (GMU), consisting of GMUs 3, 4, 5, 14, 214, 301 and 441. Whereas the White River DAU consists of GMUs 11, 12, 13, 22, 23, 24, 131, 211 and 231. For elk, this priority landscape primarily focuses on DAU E-2 and E-6; E-10 is addressed in more detail in the Book Cliffs landscape priority section.

The Bears Ears and White River mule deer and elk herds combined are estimated at 38,000 deer and 41,000 elk in 2023. These estimates are down substantially from the severe 2022-23 winter. A significant portion of each herd migrates 60 to 70 miles in spring and fall, some of the longest migrations documented in Colorado. The migratory pattern is primarily east-west, with summer ranges in the upper reaches of the Yampa and White River drainages near the Continental Divide and winter ranges west to within about 20 miles of the Colorado-Utah state line. These herds are of high importance, as they comprise approximately 21% of all deer on the western slope of Colorado and 25% of elk in Colorado.

Elk populations within these two herds are very robust and provide hunting opportunities for nearly 55,000 hunters annually from across the country. However, mule deer herds in these two units, like many other deer herds across the west, have been steadily declining over the past several decades. The White River (D-7) deer herd in particular has experienced a significant decline in the last 10-15 years. Once the nation's largest herd, with population estimates over 100,000 deer in the mid-1980s, to roughly 18,000 in 2023 with the latest drop occurring from losses suffered during the 2022-23 winter.

Spatial Location

These adjacent herd units are located within the Yampa and White River drainages between the Colorado-Wyoming state line and the White-Colorado River drainage divide (Figure 1.1).

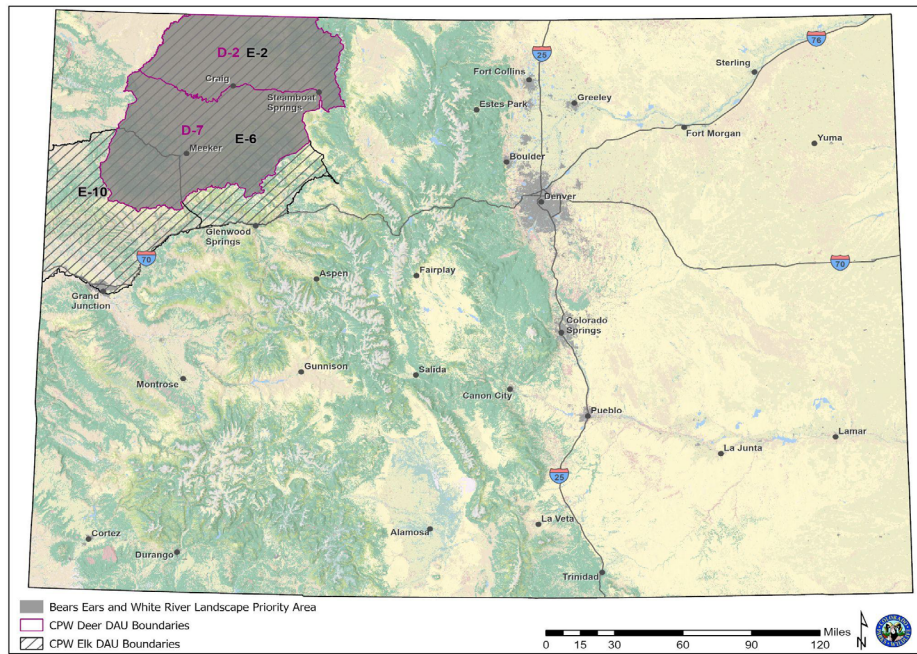


Figure 1.1. Bears Ears and White River landscape priority area in northwest Colorado. The area encompasses all of the mule deer DAU D-2, D-7 and elk DAU E-2, and a significant portion of elk DAU E-6 and the northeast portion of E-10.

Habitat Types

The varied topography and elevations in the Bears Ears and White River herd units contribute to differences in habitat across the area. Generally, vegetation types range from the montane/subalpine zone in the eastern and central of the units at higher elevations to mountain shrub-dominated vegetation at middle elevations, and sagebrush shrub lands and pinyon-juniper woodlands at lower elevations in the southern, western and northwestern portions of the herd units.

Spruce-fir and aspen stands characterize the Montane/subalpine zone. Depending on the degree of canopy closure and resultant understory of grasses and forbs, the spruce-fir areas represent moderate to good summer and fall forage for mule deer and elk. Aspen groves and associated meadows provide high quality forage from spring through fall. The Flat Tops Wilderness is composed of expansive meadows interspersed with spruce/fir stands. Aspen habitat is also extremely important as fawning areas for mule deer and calving areas for elk, especially when there is sufficient understory.

Mountain shrub vegetation consists of native grasses and Gambel oak interspersed with mountain big sagebrush. Also common are serviceberry, mountain mahogany and chokecherry. This zone, roughly from 6,500 to 8,500 feet (ft) in elevation, is very important for both food and cover. The lower half of the zone serves as a large portion of the traditional elk winter range in all but the most extreme winters. Mule deer use the lower fringe of this zone, and the sagebrush steppe at lower elevations for winter range.

Sagebrush steppe and grasslands dominate the Great Basin Zone, occurring generally below 6,500 ft. This zone is used primarily as winter range by mule deer and elk although there are some smaller bands of both species using these areas year-round. Pinyon-juniper stands are most prevalent on northern aspects of higher ridges throughout this zone. Pinyon-juniper is an important winter cover and provides limited winter forage. In areas where sufficient irrigation water exists, sagebrush flats have been converted to hay production of alfalfa or grasses such as timothy or orchard grass.

During the late 1980s and mid 1990s large-scale burns across much of the winter range have converted habitats dominated by bitterbrush, sagebrush, and pinyon-juniper to grassland habitats. These areas served as critical mule deer winter range prior to the burns, but were converted into large expanses of grasslands suitable for elk but less attractive to mule deer. Wetland/riparian vegetation types are found along the river bottoms and associated irrigated meadows. Most notable is the Yampa River corridor running first north, then east to west across the northern portion of the priority area. The White River runs east to west through the southern portion of the area.

Migration and Movements

In 2022, CPW completed a BBMM analysis¹² using 164 (D-2) and 328 (D-7) migrating GPS collared deer and 75 (E-2) and 87 (E-6) migrating GPS collared elk. During the 2024 SAM session, the generated BBMM migration corridors and additional available data and information were used by local CPW staff to map the SAM migration corridor layers (Figure 1.2 and Figure 1.3). As demonstrated by the overall migration footprint, the migratory patterns for mule deer and elk within the Bears Ears and White River priority landscape are substantial in both migratory distance and the proportion of each herd migrating seasonally. Initial findings suggest that some migration movements tend to occur quickly and with limited use of migratory stopovers. However, further analysis is needed to identify important areas and barriers within the migration corridors.

Landownership

The Bears Ears and White River priority area contain large blocks of public lands interspersed with private land holdings (Figure 1.4). The combined area encompasses 6,992 square miles consisting of the following land ownership proportions: Private lands (45%), BLM (28%), USFS (24%), State Land Board (SLB - 4%), and CPW State Wildlife Areas (<1%, approximately 35 mi²). There are over 100,000 acres of easements held in combination by CPW and other land trust organizations.

¹² Beaupre, C. 2022. Animal Sample Size Guidelines for Mapping Migrations and Distribution with GPS Collars [Unpublished bachelor's these]. Western Colorado State University, Gunnison, Colorado.

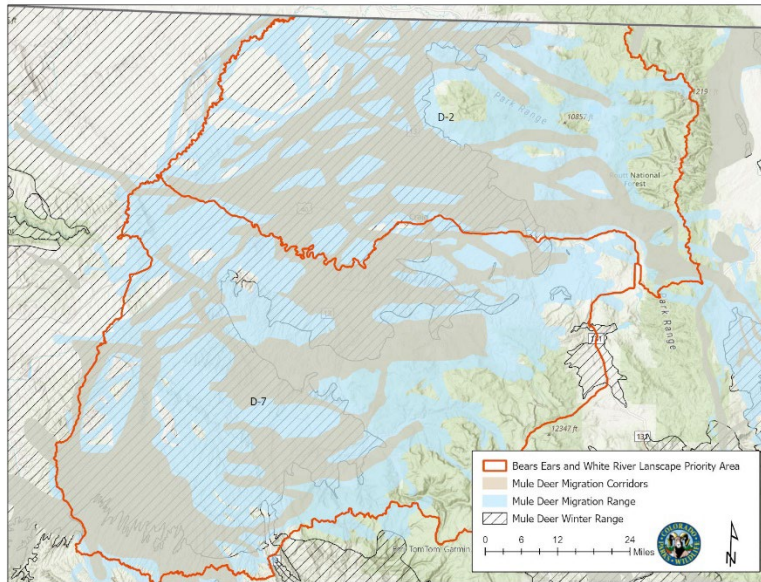


Figure 1.2. CPW Species Activity Map data of mule deer winter range, migration corridors and migration range for the Bears Ears (D-2) and White River (D-7) herds. Migration corridors are high-use migration areas derived from BBMM with staff review and edits.

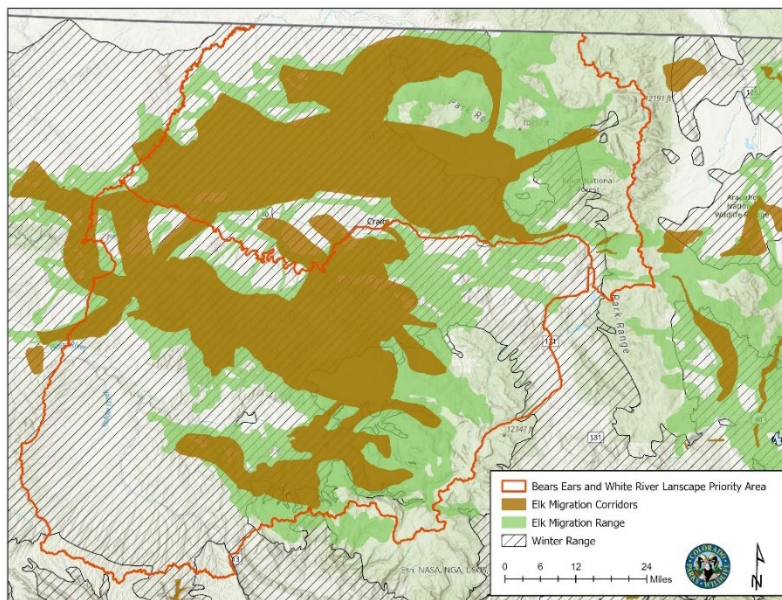


Figure 1.3. CPW Species Activity Map data of elk winter range, migration corridors and migration range for the Bears Ears (E-2) and White River (E-6) herds. Migration corridors are high-use migration areas derived from BBMM with staff review and edits.

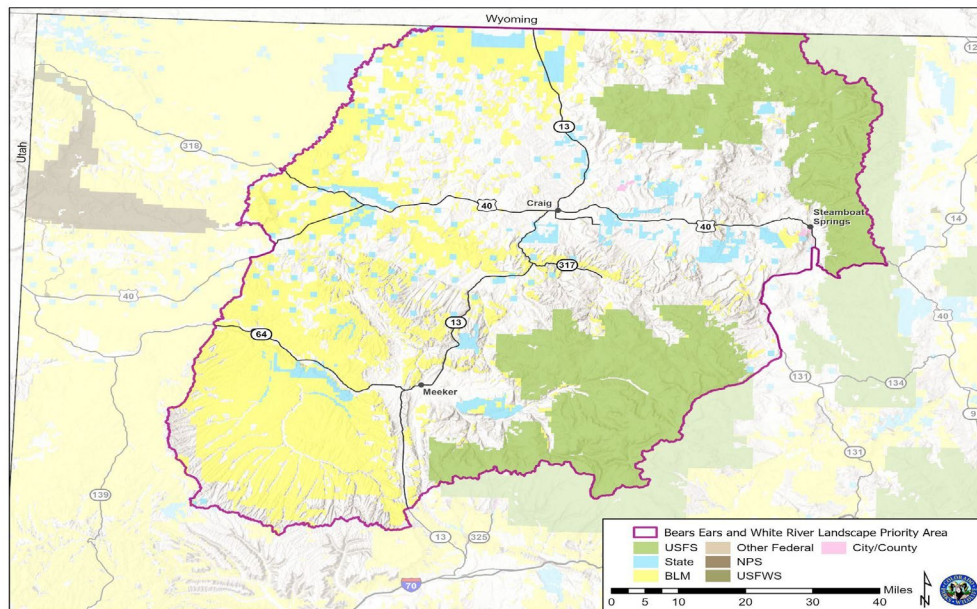


Figure 1.4. Surface landownership across the Bears Ears and White River landscape priority area.

Land Uses

The federal lands within the White River and Bears Ears herd units not designated as Wilderness are managed under a multiple-use policy. The Mount Zirkel Wilderness occurs in the eastern portion of the Bears Ears unit and the Flat Tops Wilderness falls within the southeastern segment of the White River unit. Common uses outside of the wilderness areas include livestock grazing, motorized and non-motorized recreation, and extractive energy development. Mule deer and elk migrate through parcels that have been leased for oil and gas production and active open pit coal mining operations. Private lands in the herd units are primarily used for agricultural purposes and rural residential development.

Several coalmines on privately owned parcels have reached their life expectancy and are transitioning towards obtaining bond release. Some of these acreages are being sold to developers interested in rural residential development. Other coalmines will be shutting down within the next decade and are transitioning to wind and solar developments. This major change in land use for the area will have significant impacts on both mule deer and elk habitat, particularly winter range in these units.

Hunting, including big game, waterfowl and small game, is a principal business in this priority area. Hunting directly contributes over \$50 million annually to the economy activity of Moffat, Routt, Rio Blanco and Garfield counties (2017 estimates).¹³ Hunters can pursue elk, deer, pronghorn, bear, mountain lion, rabbits, waterfowl and three species of

¹³ Colorado Parks and Wildlife. 2017. The 2017 Economic Contributions of Outdoor Recreation in Colorado, a Regional and County-Level Analysis. Southwick Associates.

grouse in the priority area.

Risk/Threats

The Bears Ears and White River landscape priority area faces many of the threats identified for big game populations across the west, these include: development pressures associated with human population growth; increased recreation pressures; climate-influenced drought, catastrophic events, and habitat alteration; loss of native vegetation; renewable energy and mineral development; incompatible livestock management practices; and transportation impacts. In addition, the prevalence of chronic wasting disease (CWD in harvested 2-year old and older bucks is over 20% in many of the GMUs within the Bears Ears and White River priority area. CWD is also present in the northwest elk herds, although the infection rate for harvest data is mostly under 5% except for GMU 211 and 12 which are 5-10% prevalence. Some of these risks are operating over the long-term; others like rural residential development are more immediate. Big game wildlife and domestic livestock heavily utilize winter ranges in this priority area.

Severe drought conditions over the past two decades have decreased forage quantity and quality, exacerbating a longer-term concern that key shrubs used as winter forage by big game are in relatively poor condition over significant portions of the priority area. More recently, summer drought conditions in 2018 were followed by a winter of heavier than average snowfall in 2018-19, which placed additional pressure on winter range vegetation. While moisture conditions in the summer of 2019 improved, 2020 and 2021 saw severe to extreme drought conditions, followed by a slight improvement in 2022 to moderate summer drought conditions. During winter 2022-23 this area experienced a historic winter event that had not been recorded in over 70 years. The severe winter zone saw persistent and extreme snow accumulations, low temperatures and wind events. These weather conditions caused hard-pack snow that completely blanketed winter forage across large areas of winter range for elk, mule deer and pronghorn. Many animals succumbed to the elements and starvation, the full extent of these conditions will probably not be known for several years. The high snow loads did produce positive benefits to vegetation production during the spring and summer providing ample forage. The severe winter conditions resulted in substantial decrease in 2023 winter population estimates. Range conditions were poor within the Bears Ears and White River priority area going into the 2022-23 winter due to persistent summer drought in previous years. Although the deep snowpack across lower elevation winter ranges across the area and more consistent summer moisture have allowed the winter range to improve, it will take several years of similar moisture to recover from the impacts of the persistent drought conditions experience over the past two decades.

Northwestern Colorado contains some of the richest oil, gas, oil shale and coal reserves in the state. Since 2009, commodity prices, relatively high cost of production and state

regulations have slowed the pace of oil and gas development since 2009. The coal-fired power plant south of Craig, CO will be shutting down by 2030, which will result in two major coalmines closing. To offset the loss of electrical transmission from the coal mines several wind and solar developments are being built or are proposed within these herd units. In addition, two large transmission lines originating from a major wind powered development in Wyoming are being constructed in the western portion of these herd units. These proposed and current developments are occurring in major migration corridors and across important winter ranges within the White River and Bear's Ears deer, elk, and pronghorn herds, and will certainly have adverse impacts to these populations. It is worth noting that the same landscape characteristics that often make sites suitable for solar facility siting, in particular (e.g., flat, unforested areas with southern exposures), contribute to landscape functionality as winter habitat and movement routes for big game species. Due to current federal requirements for security fencing to protect solar infrastructure, the installation of large-scale solar projects typically result in a complete loss of habitat for big game and other wildlife species, and can preclude occupancy, movement and habitat restoration efforts for decades. From 2017 into 2023 there have been almost 200 solar projects proposed in Colorado with potential impact to over 200,000 acres, the northwest portion of the state accounts for approximately 23,000 leased acres.

Rural residential development is proceeding at a rapid pace in several areas within the priority area. Wintering and migrating animals in this priority area are exposed to three highways (U.S. Hwy 40, CO Hwy 13, and CO Hwy 64) that bisect the long migratory path. Annual mortality of collared mule deer doe from vehicle collisions in the priority area is estimated to be approximately 2% of each herd, which is higher than doe hunter harvest in these same units. Elk mortality is lower but still substantial. Efforts to improve highway safety on any of the 3 highways would devastate these migratory paths if done without proper design and installation of highway crossing infrastructure.

Conservation Actions

Continued diligence from the BLM and the USFS in avoiding, minimizing, and mitigating the negative effects of land use developments, including recreation, on migrating and wintering deer and elk will be critically important. It is important for CPW to collaborate with land managers, industry and local governments to develop best practices to minimize impacts to wildlife and habitats from future solar developments. Counties, municipalities, and non-governmental organizations also have a role to play in properly designing and implementing land use practices within the priority area. Limitations on the timing and intensity of recreational activity on winter ranges and within migration and movement areas will be especially valuable in reducing impacts on big game.

CPW has completed a comprehensive program of monitoring and research within this priority area and has made substantial steps to implement habitat enhancement and land

protection measures. The greatest future need in this priority area is funding to implement additional habitat enhancement, conservation easement acquisition, and highway permeability with appropriately designed crossing projects. Funds allocated to this priority area would contribute to an existing landscape-scale mule deer and elk management program with a demonstrated record of success. Currently, planned habitat enhancement in this priority area consists of multiple projects involving prescribed fire, mechanical treatment of pinyon-juniper woodlands and mesic mountain shrub stands through roller chopping, hydro-ax mastication, understory enhancement on rangelands and abandoned dryland agricultural fields through reseeding or inter-seeding with diverse seed mixes including sagebrush and other shrubs and practices to reset succession or otherwise improve forage quality, quantity, and/or availability of forage to migrating or wintering big game.

Current Conservation Efforts

In response to declining deer numbers in western Colorado, CPW implemented the WSMDS beginning in 2014. The goal of the WSMDS is to work in concert with key publics and stakeholders to stabilize, sustain, and increase mule deer populations in western Colorado, and in turn, increase hunting and wildlife-related recreational opportunities. CPW has focused considerable management efforts on the Bears Ears and White River herds.

Since 2001, the White River mule deer herd has been one of the five sentinel herds for which an intensive survival monitoring study is conducted.^{14 15} Annually, a sample of 70-90 collared does and 60 collared fawns are maintained. Initially, the project utilized VHF-collars but has fully transitioned to GPS-collars. CPW is adding elk survival monitoring studies to the five existing mule deer survival study areas. The White River elk monitoring study will be initiated in the winter 2025-2026, with a sample of 90 cows and 90 calves. The primary purpose of the survival monitoring studies are to determine survival rates for both adult females and juveniles, and identify cause-specific mortality. With GPS-collar data, CPW is now able to use the location data to aid in the identification of seasonal habitats and migration corridors. Due to the longevity and primary purpose of the study, the collars have had a 12-13 hour fix rate or two points per day. Although BBMM analysis can be performed with a low fix rate to identify migration corridors, a higher fix rate of every 2 – 8 hours allows for a more robust BBMM analysis. CPW is currently seeking funding to purchase collars with higher fix rates (proposing 5 hour fix rate) on a portion of the GPS-collared cow elk. This information will allow for more fine-scale mapping of migration corridors and provide a comparison to the higher fix rate collars. The 2020 *Big Game Winter Range and Migration Corridors*¹² report defined several data gaps and management

¹⁴ Cooley C.P., et al. 2020. Colorado Parks and Wildlife, *Status Report: Big Game Winter Range and Migration Corridors*.

¹⁵ CPW Northwest Terrestrial Staff. 2023. *Final Northwest Colorado Mule Deer Herd Management Plan*.

needs that would benefit from fine scale migration location data including mapping of migration corridors, identifying physical barriers to movement, identifying pinch points, habitat quality assessment of migration corridors or transition range and determining thresholds for levels of disturbance and fragmentation for big game populations.

In addition to the survival studies, managers have also been very active in implementing landscape scale habitat treatments (Figure 1.5). Significant acreage has been treated across the Bears Ears and White River priority landscape to enhance habitat quality for big game and greater sage-grouse, but this acreage constitutes only a small portion of this landscape. The objective of this landscape scale work is to increase the ratio of forage to cover available for big game, primarily mule deer and elk. CPW has received grant funding in association with SO 3362 from the National Fish and Wildlife Foundation (NFWF) Restore grant and the Western Big Game Migration Fund to complete pinyon-juniper reduction work and fence removal. The work proposed specifically in these grants has been completed resulting in 1,238 acres of mechanical pinyon-juniper reduction and 40 miles of fence removal accomplished. Since 2020, CPW has averaged over 2,000 acres of habitat improvement work per year. In 2023, CPW was awarded \$92,000 from the NFWF Western Big Game Migration Program to continue removing obsolete fence in the northwest region of the state. Over the last 12 years, CPW managers have removed or modified over 170 miles of barbed wire and woven fence with miles of problem fence identified. Mortalities to ungulate entanglement and sage-grouse collisions have been documented in these segments.

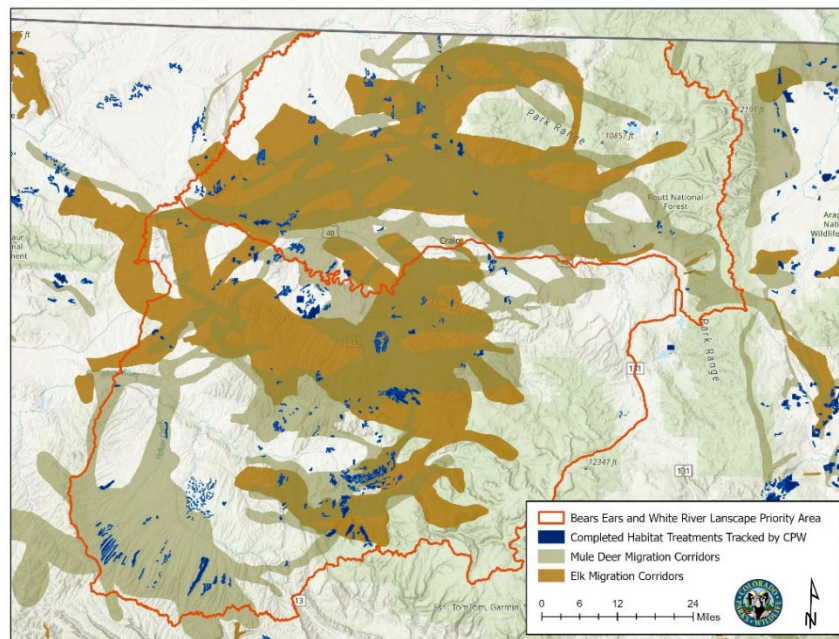


Figure 1.5. Habitat treatments implemented in the Bears Ears and White River landscape priority area mapped with elk and mule deer migration corridors.

CPW initiated an additional project to assess big game use and response to these landscape-scale treatments. This project is ongoing and will provide managers with critical temporal and spatial data to evaluate the use of current habitat treatments and help guide future habitat improvement efforts and strategies across the landscape.

In addition to these management studies, CPW has implemented several research projects to identify potential factors limiting these herds. CPW completed a 10-year (2009-2018) research project in the Piceance Basin (the southwestern portion of the White River herd unit) to assess the effects of oil and gas development on mule deer migration and to evaluate the effectiveness of industry best management practices in alleviating these effects. Additional research is underway to identify causes of reduced elk recruitment within the Bears Ears priority areas. This work is being conducted by CPW's Mammals research unit with funding support from the Rocky Mountain Elk Foundation (RMEF), Habitat Partnership Program (HPP), and a local landowner.

Unlike many places in Colorado, the landscapes within these two herd units are relatively open, intact and undeveloped. This provides a unique opportunity to protect these landscapes through conservation easements if funding were available. Since the inception of the program in 2006, the Bears Ears and White River priority area has been a focus for big game and sage-grouse habitat protection. In just this priority landscape area for projects CPW has partnered with, there has been over \$70 million spent in funding for land protection across almost 135,000 acres as of 2023. This work has been completed with many partnerships and funding sources including land trusts, federal funding, local governments, private land donations, NGOs, GOCO, and CWHF funds (Figure 1.6). This does not account for the additional thousands of acres that have been protected beyond the priority landscape boundary, or the continued need to secure land for connectivity.

Wintering and migrating animals are exposed to three highways (U.S. Hwy 40, CO Hwy 13, and CO Hwy 64) that bisect the priority area. The results of the WSWPS identified 90 miles of highway across the 3 highways as high priority segments for wildlife mitigation.¹⁶ U.S. Hwy 40, leading east and west from the town of Craig, has been selected by CDOT and CPW as one of the top highways for mitigation in the state. A current feasibility study is in progress by CDOT for four highway wildlife crossing structures on U.S. Hwy 40 between the towns of Maybell and Lay. On CO Hwy 13 near the Wyoming border, CDOT recently completed the Fortification Creek project that direct wildlife to an underpass crossing using wildlife exclusion fence and two at-grade crossings with 4-foot low-fence segments to allow animals to cross the highway where driver sight distance is more favorable. These low-fence sections create a large animal crosswalk between segments of high-fence. At the northern low-fence segment a radar wildlife detection system (WDS) was installed to alert

¹⁶ Kintsch, J., P. Basting, M. McClure and J.O. Clarke. 2019. Western Slope Wildlife Prioritization Study. Report to Applied Innovation and Research Branch Colorado Department of Transportation, Denver, CO.

motorists of wildlife approaching or crossing the highway. Escape ramps and Zap-Crete deterrent mats are also being installed. A multi- year research monitoring project of the mitigation features started in 2023. On the southern end of CO Hwy 13 north of the town of Rifle, just beyond the landscape priority boundary, three wildlife underpasses and associated infrastructure are planned for construction.

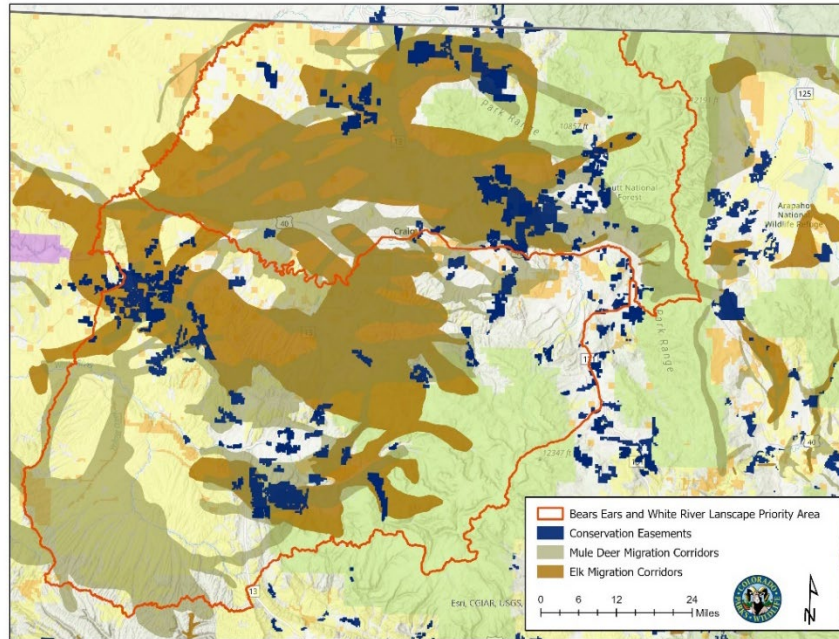


Figure 1.6. Conservation easements and landownership mapped with the Bears Ears and White River landscape priority area elk and mule deer migration corridors.

While all of these studies have provided wildlife managers with important data for informed management decisions, they have also identified the need to secure funding to continue working at a scale that will maintain the functional integrity of the landscapes in which these large migratory big game herds operate. VHF and GPS-telemetry studies conducted in these two herds to date have demonstrated that wildlife managers need to apply management actions such as habitat treatments, highway crossings, and the protection of important seasonal habitats through conservation easements at a landscape scale to adequately conserve these large and highly migratory herds.

Cost of Conservation Actions

The landscape-scale need for habitat treatments, conservation easements, and highway mitigation infrastructure necessary to improve and maintain the Bears Ears and White River winter range and migration areas cost millions of dollars. CPW continues to conduct approximately 2,000 acres of habitat enhancement with our federal and local partners annually within this priority area. CPW plans to implement an additional 1,500 to 2,000 acres of habitat enhancement annually within this area, if sufficient funding remains

available. It is anticipated that these enhancement projects will require approximately \$500,000 annually. CWHP brings approximately \$11 million or more each year to the purchase of conservation easements that protect wildlife habitat values but those funds are spread across the state and the program is extremely competitive. Properties within this priority area do consistently rank high in annual allocation. Easements are generally multi-million dollar expenditures, so the need for additional funding is essentially endless. Highway crossing infrastructure projects can range from a few to tens of millions of dollars. CPW contributed \$200,000 towards the design of the CO Hwy 13 Fortification Creek highway underpass and an additional \$200,000 towards the innovative radar wildlife detection system.

The current cost estimate for the White River elk survival monitoring study is \$275,000 for two years of capture and collaring of cow elk only. This estimate is for 90 cows in year one with a replacement of 30 collars in year two. The cost includes helicopter capture, GPS-collars, and associated collar data fees for 2-years only. Year 1 would consist of 45 Vectronic Vertex Lite, Iridium collars with 5 hour fix-rate and drop-off mechanism and 45 Vectronic Survey Globalstar collars with 13 hour fix rate, and Year 2 would be 15 each of the two collar types. The cost estimate may vary depending on labor and fuel charges, collar design and capture conditions.

#2 Colorado Landscape Priority Area: San Juan Basin (Southwest Colorado)

The San Juan Basin priority area includes DAU D-30 and E-31 and includes GMUs 75, 77, 78, 751, and 771 (Figure 2.1). As of winter 2023, the area is home to about 24,000 deer and 21,000 elk. This area contains the second largest deer herd in Colorado, and the third largest elk herd. This area has the added benefit of being multi-jurisdictional, with the majority of lands managed by the USFS, BLM, and SUIT, interspersed with private lands, and it contributes to big game movements crossing into New Mexico.

Spatial Location

The San Juan Basin is located in southwest Colorado. The southern boundary is the New Mexico state line, and the eastern and northern boundaries are the Continental Divide, with the Animas River being the western boundary.

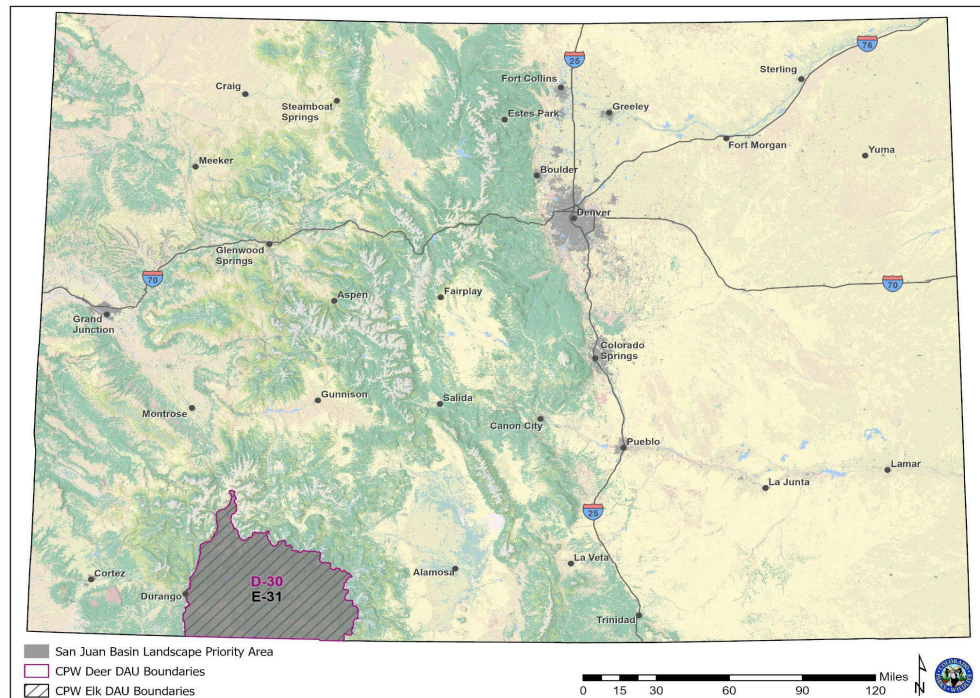


Figure 2.1. Location of the San Juan Basin landscape priority area in southwest Colorado. The area encompasses all of mule deer DUA D-30 and elk DAU E-31.

Migration and Movements

Deer and elk migration and movement areas have been documented over the last 15 years through a combination of CPW, Southern Ute Indian Tribe (SUIT), and WEST, Inc.^{17,18} Deploying GPS-collars, these studies have identified numerous discrete migration corridors and highway crossings areas for various segments of the San Juan deer and elk herds. In 2022, CPW completed a BBMM analysis¹⁹ using 143 (D30) and 108 (E31) migrating GPS-collared deer and elk, respectively. During the 2024 SAM session, the generated BBMM migration corridors and additional available data and information were used by local CPW staff to map the SAM migration corridor layer (Figure 2.2 and Figure 2.3). Previous VHF-collar studies demonstrated landscape scale connectivity but did not sufficiently identify corridors.

Landownership

The San Juan Basin priority landscape is 60% public lands including BLM, CPW, SLB and UFFS (approximately one million acres), 30% private (approximately 550,000 acres) and 11% SUIT (approximately 200,000 acres), (Figure 2.4). The landownership pattern shifts

¹⁷ Johnson, A. 2022. East Side Elk Study Final Report. Southern Ute Indian Tribe, Ignacio, CO.

¹⁸ Sawyer, H. 2018. Rosa Mule Deer Study - Final Report. Western Ecosystems Technology, Inc., Laramie, WY.

¹⁹ Beaupre, C. 2022. Animal Sample Size Guidelines for Mapping Migrations and Distribution with GPS Collars [Unpublished bachelor's these]. Western Colorado State University, Gunnison, Colorado.

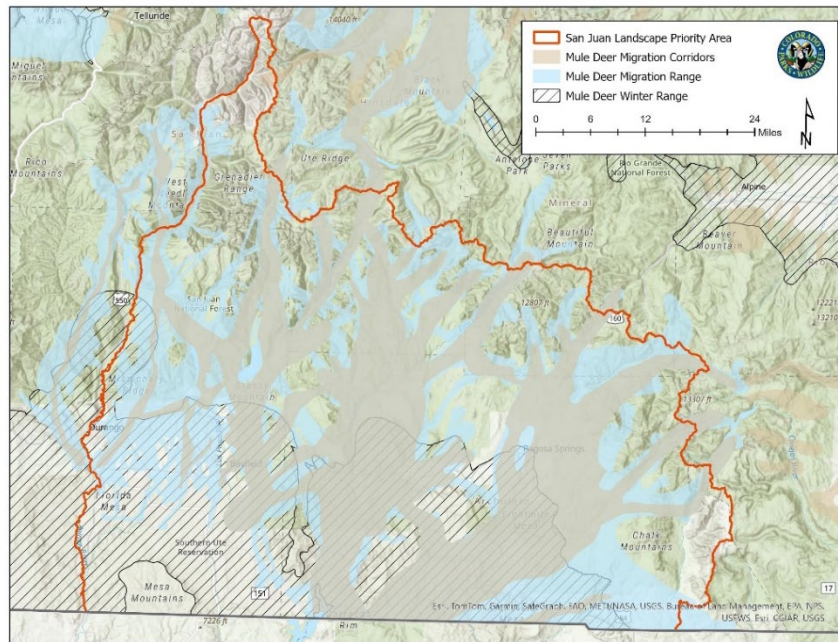


Figure 2.2. CPW Species Activity Map data of mule deer winter range, migration corridors and migration range for the San Juan Basin (D-30) herd. Migration corridors are high-use migration areas derived from BBMM with staff review and edits.

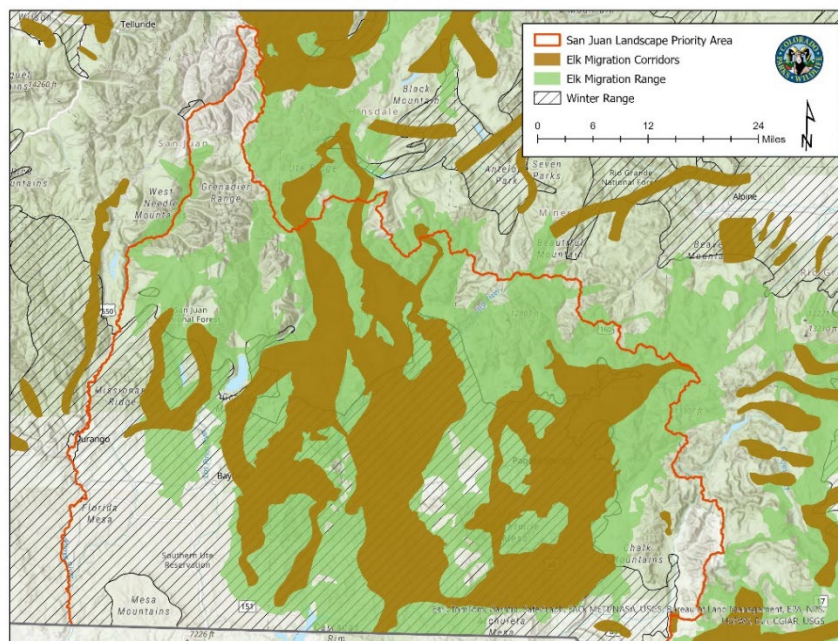


Figure 2.3. CPW Species Activity Map data of elk winter range, migration corridors and migration range for the San Juan Basin (E-31) herd. Migration corridors are high-use migration areas derived from BBMM with staff review and edits.

when you look at ownership only within winter range. Winter range is primarily privately owned (51%), (Table 2.1). The SUIT owns 20%, and the remaining 28% of winter range is publicly managed.

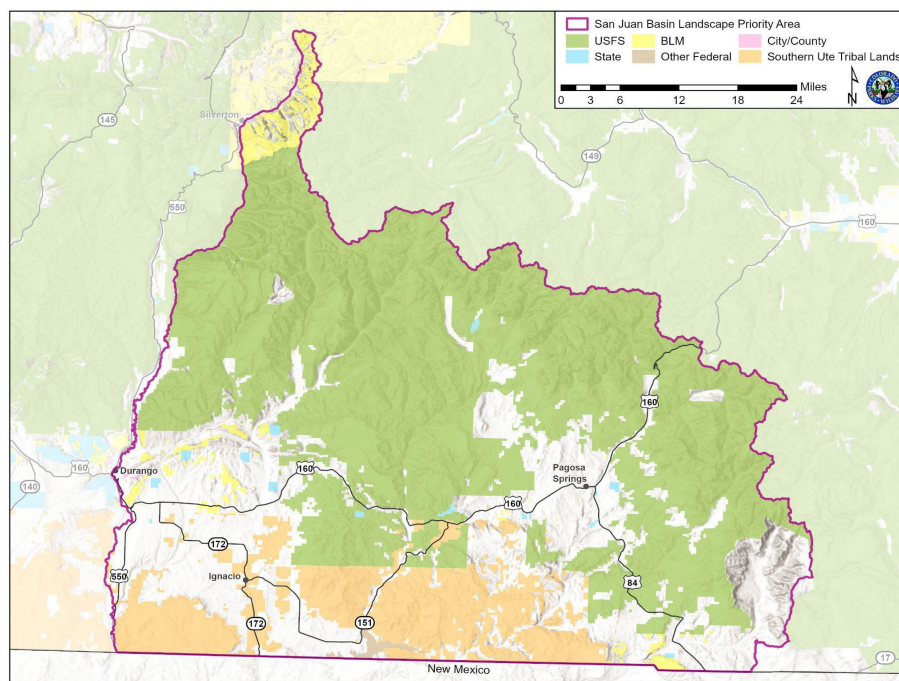


Figure 2.4. Surface landownership in the San Juan landscape priority area.

| | | Winter Range | Winter Concentration | Severe Winter Range | DAU |
|----------------|------------------|--------------|----------------------|---------------------|-------------|
| TOTAL | DAU Square miles | 1295 (46%) | 135 (5%) | 779 (28%) | 2795 (100%) |
| | BLM | 26 (2%) | 6 (4%) | 12 (1%) | 63 (2%) |
| | BOR | 2 (<1%) | 0 | 2 (<1%) | 8 (<1%) |
| | CPW | 1 (<1%) | 0 | 1 (<1%) | 2 (<1%) |
| | USFS | 332 (26%) | 25 (19%) | 98 (13%) | 1545 (55%) |
| Public Access | | 361 (28%) | 31 (23%) | 113 (15%) | 1618 (58%) |
| | Southern Ute | 264 (20%) | 7 (5%) | 183 (23%) | 320 (12%) |
| | Private | 663 (51%) | 94 (70%) | 480 (62%) | 849 (30%) |
| | State of CO | 7 (<1%) | 3 (2%) | 3 (<1%) | 8 (<1%) |
| Private Access | | 934 (72%) | 104 (77%) | 666 (85%) | 1177 (42%) |

Table 2.1 Land ownership in relation to deer and elk winter range in the San Juan Basin, Colorado.

Land Uses

The area has seen extensive exurban development in the last 20 years, replacing a primarily agricultural setting with rural residential developments. Few large landowners remain. The federal lands within the San Juan priority landscape not designated as wilderness are managed under a multiple-use policy. The Weminuche Wilderness makes up a large portion of the northern range of the priority area and the South San Juan Wilderness is on the eastern edge. Common uses outside of the wilderness areas include livestock grazing, motorized and non-motorized recreation, and extractive energy development. Extensive natural gas extraction, with associated road and pipeline have occurred on private, public and SUIT lands across the area. The exurban development and increased human population has stressed the local highway system with a high volume of high speed traffic through deer and elk habitat. Numerous wildlife crossings have been identified from previous telemetry collar studies, as well as through the WSWPS conducted jointly by CPW and CDOT.

Risk/Threats

Exurban development is occurring on much of the winter range and migration corridors in the San Juan Basin. Managers and the public are increasingly concerned over cumulative and prolonged impacts of this development disrupting big game migration and decreasing the quality and quantity of critical habitats. Development influences both the carrying capacity of the big game habitat and harvest management programs. Although development is a widespread issue, it is a considerably larger problem in portions of the San Juan Basin around the towns of Pagosa Springs, Bayfield, and Durango.

Winter range is already limited, and since it occurs at lower elevations and areas with the highest natural gas reserves it is also the habitat type that is most at risk from all forms of development. Deer and elk consume less and lose weight during the winter months and tend to conserve energy by limiting physical activity. Any disturbance that displaces deer or elk can cause them to use more energy during this vulnerable time. Such winter-time stress can lead to a higher risk of mortality, and may also negatively influence both reproduction success and fawn or calf survival later in the year. In addition, chronic wasting disease was recently detected in the San Juan deer herd, although the prevalence still estimated to be low.

As the primary land use in the San Juan area continues to transition from agricultural to rural residential, maintenance of connectivity between summer ranges and winter ranges located on public and tribal lands is a critical need. Also with the higher volume of vehicle traffic from the increase in residents and visitors, strategic placement of highway crossing structures and land protection through conservation easements will be required. The winter and transition ranges that remain intact must be maintained in the best condition possible. Opportunities for land protection are being lost to subdivisions.

Conservation Actions

CPW and partner organizations continue to seek conservation actions to maintain connectivity between deer and elk summer and winter ranges, with corridors for movement and safe passage across U.S. Hwy 160, CO Hwy 84 and U.S. Hwy 550. With the completion of the 2022 BBMM analysis²⁰ of GPS collared mule deer and elk, key lands can start to be identified to secure migration habitat to maintain permeability.

Current Conservation Effort

CPW, CDOT, SUIT, USFS, BLM are partners in various efforts across this priority landscape. As a cooperating agency on the BLM RMPA to conserve big game habitat and migration corridors, CPW continues to work with BLM to identify threats to big game populations and develop appropriate conservation actions to sustain big game herds in Colorado. The recently completed WSWPS strategically mapped deer and elk high risk highway crossings across the western slope of Colorado, identifying the need for wildlife crossing areas. Forty miles of high priority highway segments within the San Juan priority landscape were identified for wildlife mitigation.²¹ In 2022, CDOT in partnership with SUIT, CPW, NFWF, Mule Deer Foundation (MDF), RMEF and Federal Highways Administration completed the third wildlife overpass in Colorado and a wildlife underpass along U.S. Hwy 160 east of Pagosa Springs. Prior movement data also identified this area as a migration corridor for deer and elk. There is also a potential for a future wildlife underpass between Durango and Bayfield on U.S. Hwy 160. Work on a portion of Hwy 550 south of Durango was completed in 2024 which included wildlife fencing and wildlife crossing structures.

Two new coalitions consisting of a diverse partnership including people from agriculture, recreation, conservation, and hunting and fishing backgrounds was awarded funding from Colorado's Outdoor Regional Partnership in 2023 and 2024. One of the partnerships is in the eastern part of priority area and the other is in the western portion. These coalitions plan to develop common ground, share up-to-date information, and chart a course for the region to identify overarching goals and strategies related to conservation and recreation. Also, CPW is working to identify and protect priority areas for wildlife using mitigation funds paid by local oil and gas companies that have active projects in critical deer and elk habitat.

Cost of Conservation Actions

Due to the high cost of property in the San Juan Basin priority landscape, CPW has had limited opportunity to secure conservation easements. In addition, large scale habitat

²⁰ Beaupre, C. 2022. Animal Sample Size Guidelines for Mapping Migrations and Distribution with GPS Collars [Unpublished bachelor's these]. Western Colorado State University, Gunnison, Colorado.

²¹ Kintsch, J., P. Basting, M. McClure and J.O. Clarke. 2019. Western Slope Wildlife Prioritization Study. Report to Applied Innovation and Research Branch Colorado Department of Transportation, Denver, CO.

treatments and highway crossings infrastructure projects necessary to maintain the San Juan Basin deer and elk herds' network of migration corridors and important winter range are very costly, and will require several to tens of million dollars to complete.

#3 Colorado Landscape Priority Area: Uncompahgre Plateau (West-Central Colorado)

The Uncompahgre Plateau landscape priority area encompasses Colorado's D-19 deer and E-20 elk herds (Figure 3.1). Within E-20, the elk herd is managed for a quality hunting experience in GMU 61 using limited allocations of licenses, and within GMU 62 the herd is managed for hunting opportunities, with more liberal license availability. Deer numbers have seen a long, steady decline from approximately 60,000 in 1980, to 11,200 in 2023. Elk numbers peaked in 2002 at just over 14,000 and are estimated at 12,700 in 2023. Declines are the result of poor fawn/calf recruitment rates, which in turn could be attributed to persistent drought, habitat condition, forage competition, disease, human development, increasing recreational impacts, and predation.

Spatial Location

D-19 and E-20 are in west-central Colorado, south of Grand Junction, west of Montrose, and north of the San Miguel River (Figure 3.1). Because of the valued wildlife resources on the Uncompahgre Plateau, the area has been the focus of multiple research projects on deer, elk, mountain lions, and bears.

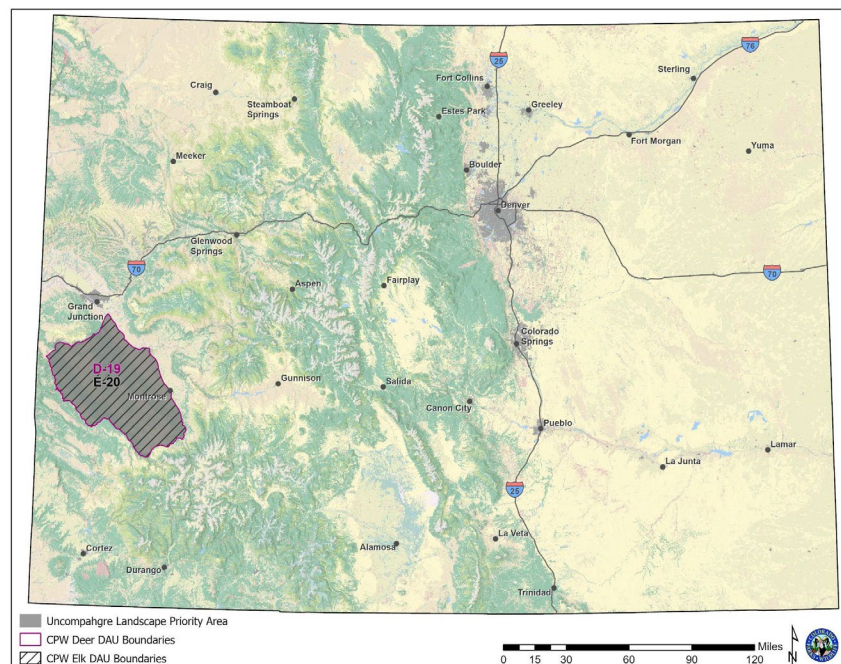


Figure 3.1. Location of Uncompahgre Plateau landscape priority area in southwest Colorado. The area encompasses all of mule deer DAU D-19 and elk DAU E-20.

Habitat Types

At elevations below approximately 6,500 ft near the Dolores, San Miguel, Uncompahgre and Gunnison Rivers, a high desert plant community is the predominant vegetation type. Important plant species of this community include four-wing saltbush, shadscale saltbush, black sagebrush, winterfat, broom snakeweed, rabbitbrush, greasewood, and, in the Gateway area, black brush. Elevations from approximately 6,000-7,500 ft, are characterized by pinyon pine and Utah juniper woodlands and grassland-shrub (e.g., basin big sagebrush, black sagebrush, Wyoming sagebrush, mountain big sagebrush, mountain mahogany, Indian ricegrass). The pinyon-juniper type covers approximately 40% of the Uncompahgre Plateau priority area and is the predominant plant community. From approximately 7,500 to 8,500 ft, ponderosa pine and mountain shrub are the dominant vegetation type. Elevations above 8,500 ft are generally aspen forests and a mixed spruce-fir complex. Common plant species found in lowland riparian areas include narrowleaf cottonwood, coyote willow, chokecherry, tamarisk, and boxelder. In higher elevation riparian areas, species include thinleaf alder, birches, willows, and blue spruce.

Agricultural areas and cultivated croplands within the DAU occur primarily in the Uncompahgre Valley between Montrose and Delta and in the other major river valleys surrounding the Plateau.

An additional note for 2024 is the Bucktail Fire. The Bucktail Fire started on August 1, 2024 near the Delta-Nucla road in Nucla, Colorado in GMU 61. The fire is currently in the demobilization stage focusing on clean up and monitoring the fire perimeter, but has burned approximately 7,200 acres thus far. The estimated containment date is September 30, 2024. This fire is currently burning in elk and deer winter range and winter concentration areas which should ultimately improve this crucial wildlife habitat.

Migration and Movements

In 2022, CPW completed a BBMM analysis²² using 108 (D19) migrating GPS collared deer. During the 2024 SAM session, the generated BBMM migration corridors and additional available data and information were used by local CPW staff to map the SAM migration corridor layer (Figure 3.2). Migration timing on the Uncompahgre Plateau can take place over a day or two for some deer. Spring migration may be slower if snow is persistent at higher elevations, but fall migration is usually quick. Some deer that migrate south off of the Uncompahgre Plateau may take longer. The Horsefly Peak and the area around the Cornerstone subdivision may be a stopover or holdover area for migrating animals. More investigation into the timing and reasons for holdovers on private lands in this area need to be studied. Fall migration stopover may occur in the Gambel oak habitat if deer slow their

²² Beaupre, C. 2022. Animal Sample Size Guidelines for Mapping Migrations and Distribution with GPS Collars [Unpublished bachelor's these]. Western Colorado State University, Gunnison, Colorado.

movements to feed on acorns. CPW is currently conducting an elk GPS collar research project within the priority landscape. Elk migration corridors have been mapped through the CPW SAM mapping process (Figure 3.3).



Figure 3.2. CPW Species Activity Map data of mule deer winter range, migration corridors and migration range for the Uncompahgre Plateau herd (D-19) herd. Migration corridors are high-use migration areas derived from BBMM with staff review and edits.

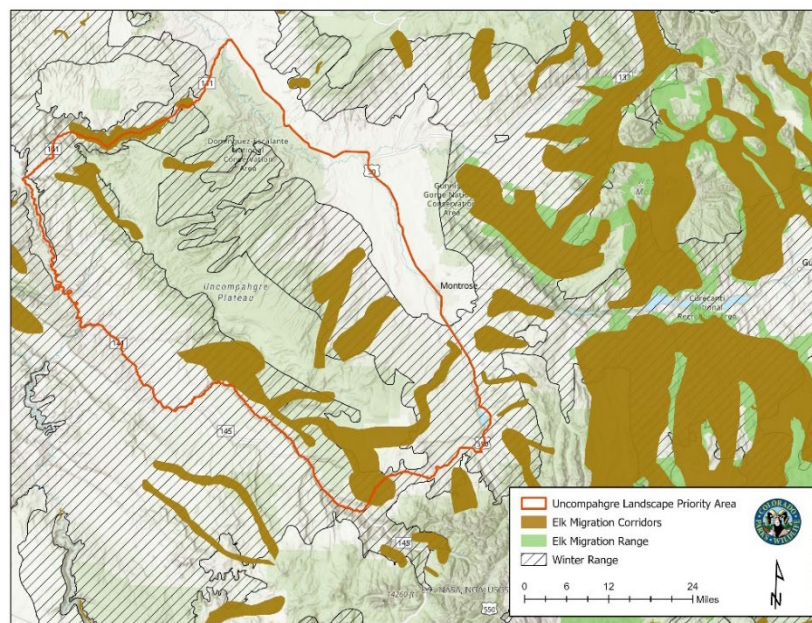


Figure 3.3. CPW Species Activity Map data of elk winter range, migration corridors and migration range for the Uncompahgre Plateau (E-20) herd. No GPS collar data exists for this herd, migration corridors are mapped using the CPW SAM mapping methodology.

Landownership

Land ownership in DAU D-19 is 24% private, 38% BLM, 37% USFS, and 1% CPW and SLB (Figure 3.4). Municipalities that border the DAU include Montrose, Delta, Olathe, Ridgway, Norwood, Nucla, Naturita, and Gateway.

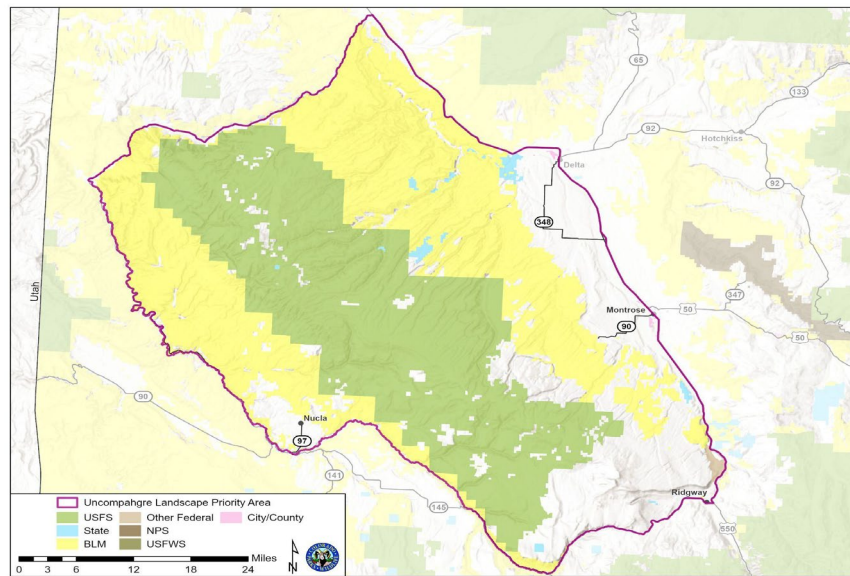


Figure 3.4. Surface landownership in the Uncompahgre Plateau landscape priority area.

Land Uses

Agriculture is one of the primary land uses within D-19, with irrigated farmland primarily along the edges of the DAU and extensive cattle and sheep grazing across public and private lands. Recreational activities including hunting, hiking, horseback riding, fishing, wildlife viewing, photography, four-wheeling, off-highway vehicle (OHV) use, snowmobiling, cross-country skiing, and mountain biking have always been part of the landscape. However, over the last 15 years OHV use and mountain biking have seen the greatest growth, as local communities support the development of mountain biking and Jeep/OHV trails on nearby public lands to create destinations for recreation and to increase local revenue at the expense of wildlife populations. Additional land uses include mining and timber harvest. Historically, the area supported extensive mining for uranium, vanadium and coal, but currently gravel is the primary material being mined. Timber harvest has ebbed and flowed over the years, but currently there has been more prescribed and stewardship cutting taking place to improve forest health. Montrose is home to one of the largest timber mills in Colorado, processing trees from all over Colorado.

Risk/Threats

The Uncompahgre Plateau landscape priority area faces many of the threats identified for big game populations across the west, these include: development pressures associated with human population growth; increased recreation pressures; climate-influenced drought, catastrophic events, and habitat alteration; loss of native vegetation; energy and mineral development; forage competition; and transportation impacts. In addition, the prevalence of chronic wasting disease from deer harvest data is estimated at 13.8% in the Uncompahgre Valley which is an increase from 3.4% in prior testing efforts. CWD has also been detected in the elk herds but at a prevalence rate of less than 5%. Some of these risks are operating over the long-term; others like rural residential development are more immediate and include habitat loss from development of golf courses and houses in migration corridors, winter range, and production areas.

Decreasing habitat quality from drought impacts are leading to poor shrub vigor, declining aspen health, pest and disease infestation to Douglas-fir and spruce fir communities and increasing noxious weeds. With on-going climate change impacts there is also a shift on winter ranges from cool season to warm season grasses, as well as decreasing shrub vigor and increasing grass understory. All of these stressors on forage availability lead to increased competition for forage between deer and elk as well as with livestock.

As in most areas across Colorado and other western states, the Uncompahgre Plateau priority area is experiencing an increase in recreational use, motorized and non-motorized users. This change has been noticed during CPW hunter check stations, where more non-consumptive recreational users are checked than hunters on opening day.

Old sheep allotment fences remain in many areas across the Uncompahgre Plateau priority area. Woven sheep fence inhibit and in some cases prohibit movement of ungulates, especially when located within fawning and calving habitat. Juvenile deer and elk cannot jump sheep fences and become susceptible to predation, abandonment and injury.

The recently completed WSWPS strategically mapped deer and elk high risk highway crossings across the western slope of Colorado, identifying the need for wildlife crossing areas. A 2.5 mile segment along U.S. Hwy 550, south of Colona, was identified in the top 5-10% of the WSWPS.²³ CDOT has existing exclusionary fence in the northern segments that hinders ungulate movement due to inadequate available crossing structures to facilitate deer and elk herd movements. While fencing can protect drivers and wildlife from conflicts, it creates a barrier that inhibits wildlife movement if not combined with appropriately planned crossing infrastructure. As the human population in the area

²³ Kintsch, J., P. Basting, M. McClure and J.O. Clarke. 2019. Western Slope Wildlife Prioritization Study. Report to Applied Innovation and Research Branch Colorado Department of Transportation, Denver, CO.

increases, mule deer migration and movement is inhibited by traffic along U.S. Hwy 550 and CO Hwy 62.

Conservation Actions

The threats within the Uncompahgre Plateau priority area are immediate and long-term. Habitat loss to development has been occurring and will continue to occur on private lands. Conservation easements have been used to protect private property, however, land values on the southern end of the priority area are very high, making acquisition cost prohibitive. Habitat quality could improve with more consistent precipitation, however, long term trends have been much drier than in previous decades even with winters of high snowpack. Additionally, while livestock and big game numbers across the Uncompahgre have decreased compared to historic high numbers, long term impacts on vegetation remain and important browse plants are especially slow to respond following the drought conditions observed over the last 20 years.

Continued diligence from the BLM and the USFS in avoiding, minimizing, and mitigating the negative effects of land use developments, including recreation, on migrating and wintering deer and elk will be critically important. It is important for CPW to collaborate with land managers, industry and local governments to develop best practices to minimize impacts to wildlife and habitats from future solar developments. Counties, municipalities, and non-governmental organizations also have a role to play in properly designing and implementing land use practices within the priority area. Limitations on the timing and intensity of recreational activity on public winter range and within migration and movement areas will be especially valuable in reducing impacts on big game. Also, CPW should assist USFS and BLM with closing roads and with developing educational materials for trail users about impacts to wildlife and habitat from trail use during critical times of the year.

Developing conservation easements to protect important winter range and maintain habitat connectivity and permeability are important for ungulate population longevity. Unfortunately, high and inflated property values in the Uncompahgre Plateau landscape priority area make it difficult to secure land protections on private lands. A critical parcel of private land to protect and maintain permeability for migrating deer and elk is located in the southern end of the priority area and north of Horsefly Peak. CPW can partner with other conservation partners, such as the Colorado West Land Trust, to increase focus to big game migration corridors and important winter ranges.

Additional projects include removing or modifying fencing to make fencing more wildlife friendly. Cooperation with landowners to replace or modify woven-wire fence with wildlife-friendly fence design would increase permeability for young deer and elk. Options include adding drop gates that can be opened after livestock move off range or

breaks in woven wire in designated areas to allow deer and elk to pass under or over but restrict cattle movement.

It is important to continue to implement habitat treatments in or adjacent to key winter ranges as identified in CPW's WSMDS. Key outcomes from treatments will be improved sagebrush communities: decreased weeds, increased grass and forb diversity, decreased bare soils, and a possible shift from warm season winter range communities back to cool season grasses. NEPA is complete for the Dry Mesa and Escalante Canyon areas.

Current Conservation Efforts

CPW, CDOT, USFS, BLM, and private landowners are partners in various efforts across the Uncompahgre Plateau priority area. As a cooperating agency on the BLM RMPA to conserve big game habitat and migration corridors, CPW is working with BLM to identify threats to big game populations and develop appropriate conservation actions to sustain big game herds in Colorado.

The 2019 WSWPS strategically mapped deer and elk high risk highway crossings across the western slope of Colorado, identifying the need for wildlife crossing areas. One of the top 5% segments identified was the Billy Creek area south of Montrose. CDOT is completing construction of an underpass north of the CPW Billy Creek State Wildlife Area to improve safe passage of wildlife in this area. Deer and elk are also known to move north-south across CO Hwy 62; there may be segments along this stretch that could also benefit from adequately sized crossing structures and associated infrastructure.

Projects in response to the WSMDS are being conducted in cooperation with the BLM, USFS, and MDF to improve habitat through pinyon-juniper thinning on winter ranges, seeding a recent large wildfire area, and improving pasture fencing. Examples of the projects include: BLM completing approximately 1,800 acres of PJ mastication, and lop and scatter projects, in which 300 acres received seed provided by CPW and a 423 acre big game winter range improvement project in the Burn Canyon area; the USFS is currently in the planning phase to conduct projects to improve forest resilience and enhance wildlife habitat by using prescribed fire, timber harvest and hand clearing. Key outcomes from treatments will be improved sagebrush communities: decreased weeds, increased grass and forb diversity, decreased bare soils, and a possible shift from warm season winter range communities back to cool season grasses.

In 1997, CPW began a deer survival study investigating doe and 6-month fawn survival rates as a result of declining deer populations. The Uncompahgre Plateau mule deer herd was one of the original study areas.²⁴ ²⁵Annually, a sample of 70-90 collared does and 60

²⁴ Cooley C.P., et al. 2020. Colorado Parks and Wildlife, *Status Report: Big Game Winter Range and Migration Corridors*.

²⁵ CPW Southwest Terrestrial Staff. 2024. *Mule Deer Herd Management Plans Colorado Parks and Wildlife Southwest Region*.

collared fawns are maintained. Initially, the project utilized VHF-collars but has fully transitioned to GPS-collars. The primary purpose of the survival monitoring studies are to determine survival rates for both adult females and juveniles, and identify cause-specific mortality. With GPS-collar data, CPW is now able to use the location data to aid in the identification of seasonal habitats and migration corridors. Due to the longevity and primary purpose of the study, the collars have a 12-13 hour fix rate or two points per day. Although BBMM analysis can be performed with a low fix rate to identify migration corridors, a higher fix rate of every 2 – 8 hours allows for a more robust BBMM analysis. CPW is currently seeking funding to purchase collars with higher fix rates (proposing 5 hour fix rate) on a portion of the GPS-collared mule deer does in the Uncompahgre Plateau herd. This information will allow for more fine-scale mapping of migration corridors and provide a comparison to the higher fix rate collars. The 2020 *Big Game Winter Range and Migration Corridors*²⁶ report defined several data gaps and management needs that would benefit from fine scale migration location data including mapping of migration corridors, identifying physical barriers to movement, identifying pinch points, habitat quality assessment of migration corridors or transition range and determining thresholds for levels of disturbance and fragmentation for big game populations.

Research is underway to identify causes of reduced elk recruitment plaguing southern Colorado. This work is being conducted by CPW's Mammals research unit with funding support from the RMEF, HPP and a local landowner.

Cost of Conservation Actions

CPW's WSMDS habitat improvement projects across the Uncompahgre Plateau have been taking place over the last few years. To date approximately \$375,000 has already been spent by CPW, SCTF, and GOCO to implement seeding on the Bull Draw fire and on mastication projects.

Many programs exist to implement conservation actions. Wildlife-friendly fencing programs cost approximately \$7,500/mile with a cost share at 50%. Projects to work with BLM and USFS to sign closure areas to protect big game winter range would only cost about \$2,000 per year. Compared to conservation easements and fee title acquisition projects which can cost several to tens of millions of dollars to complete.

Habitat improvements within the Uncompahgre Plateau priority landscape are estimated to cost about \$150,000 per year to complete. One area that is cleared by NEPA is from Dry Mesa to Escalante Canyon. In addition, there are opportunities to improve the winter range for deer to meet objectives in the WSMDS within GMU 61. Funding to assist with completion of NEPA compliance would be beneficial and cost approximately.

²⁶ Cooley C.P., et al. 2020. Colorado Parks and Wildlife, *Status Report: Big Game Winter Range and Migration Corridors*.

The recently completed CDOT Billy Creek fencing and an underpass project south of Montrose cost approximately \$700,000 for the structure and another \$250,000-\$300,000 for construction.

The current cost estimate for the Uncompahgre Plateau mule deer survival monitoring study is \$50,000 for two years of capture and collaring of 15 mule deer does. This estimate is to replace collars lost to mortality or collar failure to maintain the 70-90 does annually. This is also for the current Vectronic Survey Globalstar collars with 13 hour fix rates or two locations per day. The cost estimate may vary depending on labor and fuel charges, collar design and capture conditions.

#4 Colorado Landscape Priority Area: Piney River/State Bridge (Northwest Colorado)

The Piney River/State Bridge priority area includes approximately 40% of the State Bridge deer herd (DAU D-8) and all of the Piney River elk herd (DAU E-12). Specifically, the priority area includes GMUs 35, 36, and 361. At approximately 13,100 deer, the State Bridge deer herd is one of the ten largest herds on the western slope of Colorado. The Piney River elk herd includes approximately 3,800 animals. While both species are within CPW's long-term population objective for the herds, habitat carrying capacity has declined over recent decades, as both the quantity and quality of habitat have diminished due to land development, decreased precipitation, fragmentation by roads and trails, increased human activity on public lands, and suppression of large-scale wildfires.

Spatial Location

The Piney River/State Bridge landscape priority area is located in north-central Colorado. The area occurs in northern Eagle and southwestern Grand counties and is bounded on the north by the Colorado River and on the south by the Eagle River and Interstate 70 (I-70). The eastern boundary reaches alpine habitat along the Gore Range, which traverses south to Vail Pass. I-70 passes through the mountain ski town of Vail in the east and several additional mountain towns, including Avon and Eagle (Figure 4.1). The Piney River/State Bridge priority area is approximately 620 square miles in size.

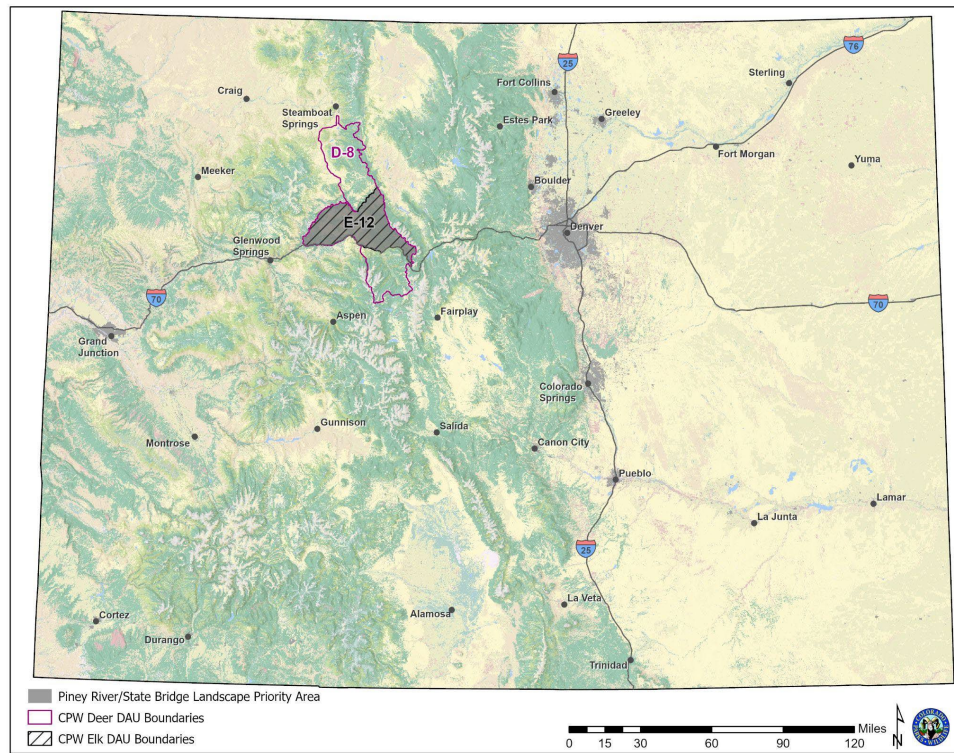


Figure 4.1. Location of the Piney River/State Bridge landscape priority area in northwestern Colorado. The area encompasses a portion of mule deer DAU D-8 and all of elk DAU E-12.

Mule deer and elk winter range is concentrated in the central and western portions of the priority area. The Piney River/State Bridge priority area occurs at relatively high elevation. Snowfall is heavy and persistent for many months in most years. Consequently, south-facing slopes at lower elevations in the central and western portions of the area are of critical importance. Approximately one third of the area provides suitable winter range for deer, and elk winter in about half of the priority area. Two thirds of the winter range is on public land, with the remaining third in private ownership. The highest density of wintering mule deer occurs along slopes lining the north side of the I-70 corridor and along CO Hwy 131. Elk winter use is greatest in the north-central portion of the priority area, with lower levels of use along the I-70 corridor and the Colorado River.

The majority of deer and elk in the priority area migrate from higher elevation summer range to these winter ranges in the fall and early winter and reverse the pattern in the spring. Unfettered access to these winter range areas is of critical importance, as deer and elk seek wintering ranges where snow depths are lower and winter temperatures are higher. Although there is a lack of deer and elk collar data to help detect migration corridors, land managers over the years have identified two key migration corridors. The first, and most significant, runs east to west along the north side of I-70. It is particularly important for deer. The second key area is associated with the Dowd Junction highway underpass at the eastern end of the priority area west of Vail. Maintenance of free

movement to and from this underpass is of high importance for deer that migrate between summer ranges south of I-70 and winter ranges in the priority area to the north of the Interstate. Mule deer and elk winter range concentrations modeled from flight classification data are shown in Figures 4.2 and 4.3, respectively.

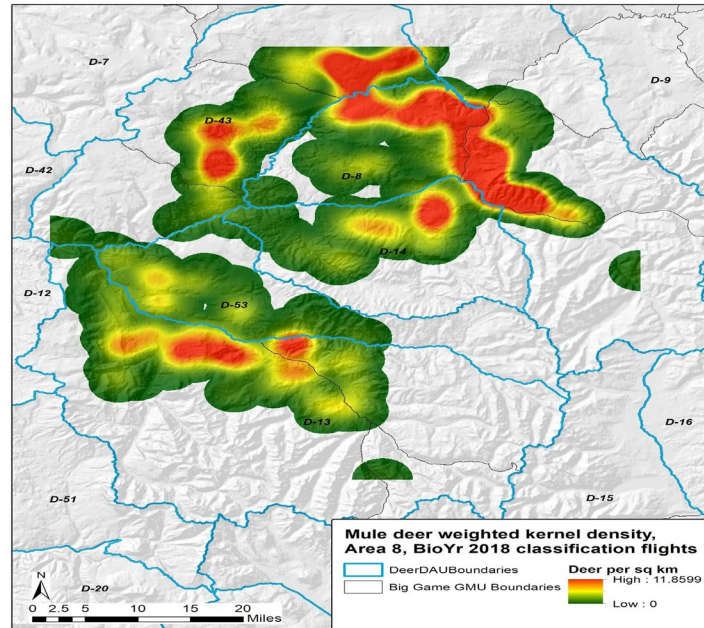


Figure 4.2. Mule deer winter range density modeled from flight classification data in the Piney River/State Bridge (D-8) landscape priority area.

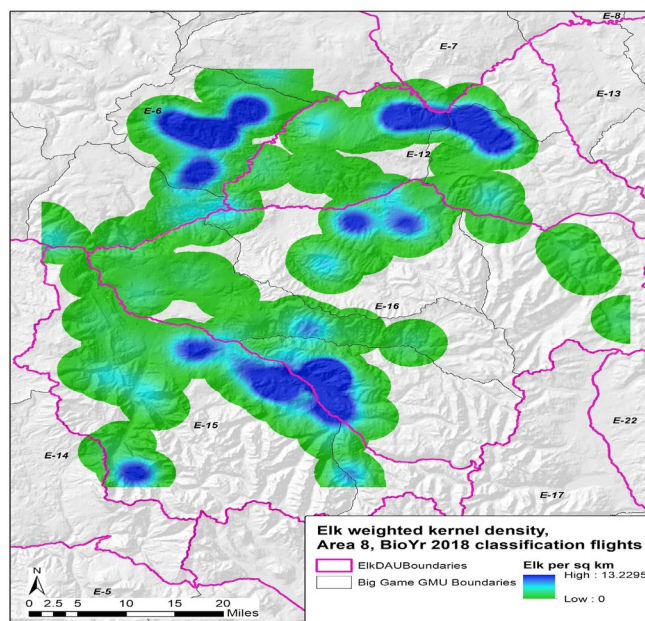


Figure 4.3. Elk winter range density modeled from classification flights in the Piney River/State Bridge (E-12) landscape priority area.

Habitat Types

Vegetation types in this unit are largely determined by elevation and aspect. Topography in the priority area is highly varied. The Gore Mountain Range, along the eastern boundary, has elevations in excess of 13,000 ft. Low-lying regions are found adjacent to the Colorado River, with an average elevation of just over 6,000 ft.

Above approximately 12,500 ft, the mountain peaks in the Gore Range are mostly bare rock or alpine communities. Spruce-fir forest occurs between the elevations of 8,000 and 12,500 ft. Aspen and aspen-conifer mixes dominate the slopes from 7,000 to 8,500 ft. Mountain shrub communities occur primarily on lower slopes near 7,000 ft. In the western two-thirds of the area, pinyon-juniper woodland covers the foothills, and sagebrush parks appear on more level sites as elevation drops. Aspen is found mostly on sites that have been burned or disturbed within the past 150 years. Major vegetation categories are shown in Figure 4.4.

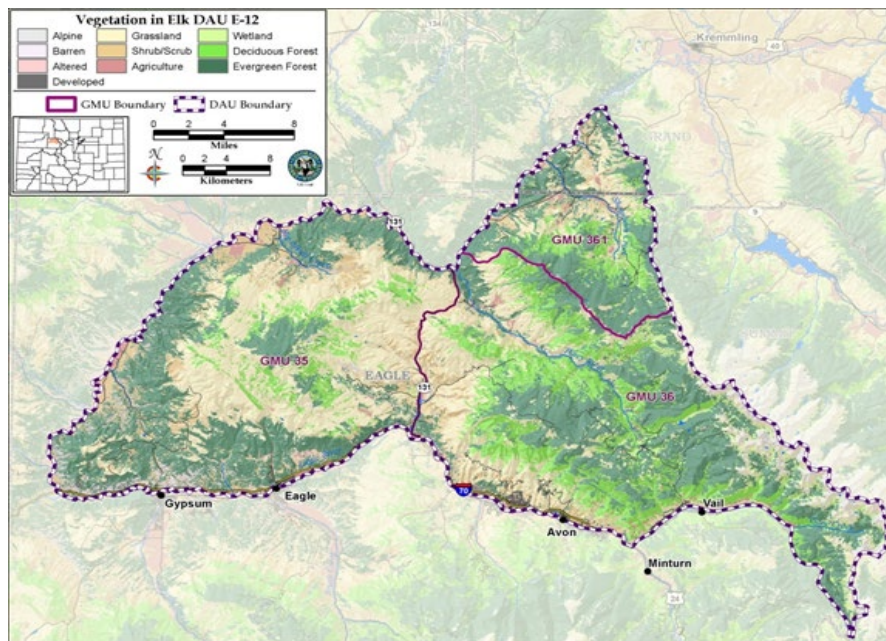


Figure 4.4. Vegetation communities within the Piney River/State Bridge landscape priority area.

Migration and Movements

Specific migration routes in the Piney River/State Bridge priority area have not been delineated using BBMM methodology since GPS collar data for deer and elk do not exist in the priority area. Migration corridors are mapped during the SAM session using survey data and observational information from local staff (Figure 4.5).

CPW will be starting a GPS-collaring project of female deer and elk to characterize seasonal ranges and habitat selection, beginning with elk in winter 2024-25 and deer in

winter 2025-26. GPS data will be collected at a 5-hour fix rate to optimize battery lifespan for an estimated 6 years for the elk collars and 4 years for the deer collars. These data may also be useful for identifying movements and migration corridors at the seasonal scale.

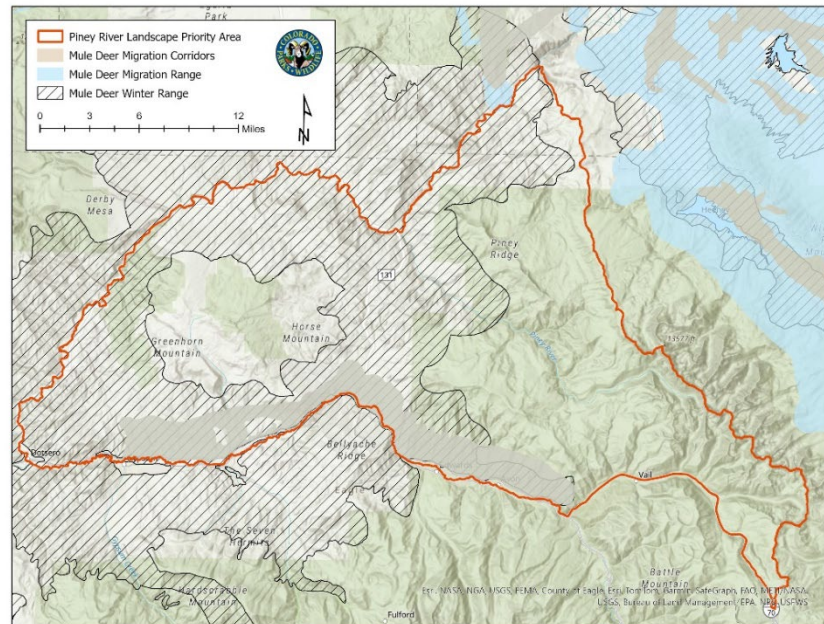


Figure 4.5. CPW Species Activity Map data of mule deer winter range, migration corridors and migration range for the Piney River/State Bridge (D-8) herd. No GPS collar data exists for this herd, migration corridors are mapped using the CPW SAM mapping methodology.

Landownership

The Piney River/State Bridge priority area is 75% federal land (approximately 140,000 acres BLM and 160,000 acres of USFS lands) and 23% private land (93,000 acres), with the remainder owned by the CPW and other entities. CPW owns less than 1%, primarily along the Eagle River for fishing access and the Radium State Wildlife area in Grand County. The Eagle's Nest Wilderness makes up 13% of the priority area. The eastern half of the priority area is USFS, with BLM ownership predominant in the western half (Figure 4.6).

Land Uses

Land use is varied and diverse in the Piney River/State Bridge priority area. The main industries are tourism, outdoor recreation, ranching, construction, real estate and logging.

The local economy is strongly influenced by tourism. I-70 along the southern edge of the priority area is the major east-west artery through Colorado's Rocky Mountains. The main tourist attractions in the vicinity are the Vail and Beaver Creek Ski areas, located just south of the priority area. These resorts have shifted recreational activity in recent years from winter-only ski areas to four-season resorts that draw visitors for a variety of outdoor

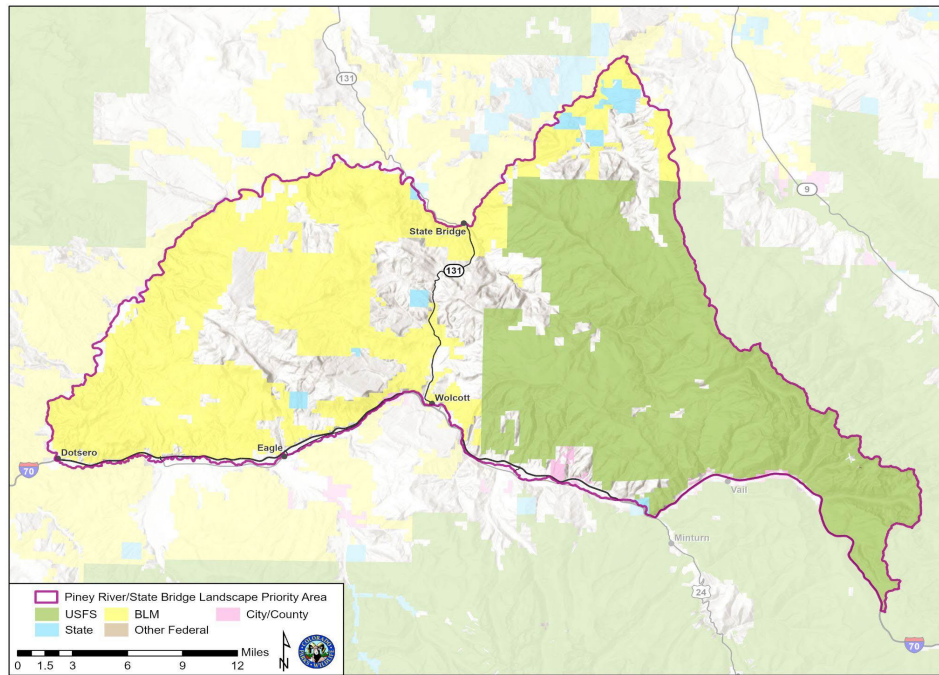


Figure 4.6. Surface landownership in the Piney River/State Bridge landscape priority area.

recreational activities throughout the year. Increased recreational activity at these resorts has spilled over onto adjacent public lands beyond the ski resorts within the priority area as well. Over the past 10 years, the priority area has experienced rapid expansion of non-consumptive outdoor recreation activities, especially mountain biking and backcountry skiing, but also hiking, trail running, motor biking, ATV/UTV riding, snowmobiling, and horseback riding. The area also supports substantial wildlife-related recreation, including hunting and fishing.

Construction and real estate development and sales are also major industries in the area, and are fueled in part by the increase in recreational activity. Unfortunately, many of the new developments are located in mule deer and elk winter range. Approximately 30% of the winter range in the priority area is privately owned, much of which has already been developed or may be subject to residential and commercial land development in the future. Over the past 30 years, this development has been focused along the I-70 and CO Hwy 131 corridors. The density of residential development varies from suburban housing to larger exurban ranchettes.

Public land in the priority area is used for both cattle and sheep grazing, although livestock grazing on private lands has declined with the general decline in agriculture as lands are converted to residential use. The BLM administers all or part of 34 active grazing allotments in the priority area. Livestock use occurs primarily in the spring, summer, and fall. The USFS administers 8 active grazing allotments, occurring totally or partially in the priority area. The period of livestock use on the National Forest varies, but primarily occurs from

late June through October. Grazing practices have changed greatly since the 1960s, such that impacts of livestock on the land are much less today than in the late 19th and early 20th centuries.

Other commercial land uses in the priority area include logging and mining. Commercial logging has occurred in several portions of the priority area in the past. The area's forests have experienced a significant bark beetle outbreak in recent years which has also contributed to a change in forest cover and has resulted in additional timber management activities. The USFS has several active or future timber sales planned in these areas. Cinders are mined for making blocks and for road surfacing at the Dotsero volcanic site in the western portion of the priority area. Gypsum is mined just north of the town of Gypsum for the local wallboard plant. There have been several oil and gas wells drilled in the priority area since 1940, but most of these were not productive.

Risk/Threats

The most significant threats to deer and elk in this priority area are the rapid expansion in the intensity and duration of year-around recreational activity and the associated increase in residential and commercial development. Both lead to reduction in the amount and quality of winter range, as well as the ability of deer and elk to migrate successfully to and from these winter ranges. As noted above, the Piney River/State Bridge priority area occurs at relatively high elevation and receives considerable snowfall that persists through a long winter season. Consistent access by deer and elk to south-facing slopes within the priority area, particularly the ability of deer to reach and winter on the slopes within a few miles north of I-70 and on either side of CO Hwy 131, is critical to the conservation of these herds. In addition, CWD is present in deer within the priority area, currently less than 5% prevalence rate in harvested bucks. CWD has not been detected in elk within the priority area, however CWD has been detected in adjacent units.

The incidence of wildlife-vehicle collisions along I-70 has been high in the past, leading to the installation of exclusionary fence along many miles of the interstate in the priority area to increase safety to the traveling public. While adequate escape ramps have been constructed to allow animals to exit the fenced right of way, limited wildlife crossing structures are planned in this area. There is one small box culvert at Dowd Junction that was installed in 1969 to allow passage of deer under I-70. The structure is inadequate in size and fencing to successfully pass most animals, and there is human disturbance from the paved pedestrian path that runs near the structure. CO Hwy 131 bisects high-density deer winter range north of I-70 and Wolcott and contributes to a high number of deer mortalities. Traffic volume along this highway is relatively low but is increasing as the level of recreation and residential development grows to the north in the town of Steamboat Springs.

There are both long-term and immediate components to the threats facing wintering and migrating deer and elk in the Piney River/State Bridge priority area. The intensity and

duration of recreational activity is increasing rapidly year by year. The White River National Forest is the most visited forest in the National Forest system. Rapidly developing mountain bike designs and increased prevalence of off-highway vehicles are expanding the ability of people to reach formerly remote and inaccessible wildlife habitats year-round.

Residential and commercial development associated with local ski areas has been occurring for more than 40 years and has accelerated in recent decades. Much of this development has occurred on privately owned winter range. Several large ranches, particularly in the eastern portions of the priority area, have been purchased by owners who intend to maintain the properties in an undeveloped state. Few are protected by conservation easements, but they have served to conserve key habitats nonetheless. This shift of private land away from production agriculture has moderated the effect of livestock grazing on large areas of private land, and on federal lands to a lesser degree, but winter range habitat condition in the priority area is still depressed through the persistent degradation caused by historic grazing practices and the successional effects of long-term fire suppression.

Conservation Actions

Several actions may be successful in reducing or eliminating these threats. First and foremost, continued diligence from the BLM and the USFS in avoiding, minimizing, and mitigating the negative effects of land use developments, including recreation, on migrating and wintering deer and elk will be critically important. Counties, municipalities, and non-governmental organizations also have a role to play in properly designing and implementing land use practices within the priority area. Limitations on the timing and intensity of recreational activity on publicly owned winter range will be especially valuable in reducing impacts on big game. In addition, to having adequate personnel to enforce regulations and rules.

Protection of privately owned migration areas and winter ranges through the implementation of conservation easements will also benefit conservation of limited winter ranges in the priority area. Unfortunately, land value in the priority area is high and rising, adding to the costs of conservation easements with each passing year.

Identification and construction of strategically designed and located highway crossing structures could conserve, and in some cases restore, permeability for migrating wildlife. This will be particularly important along CO Hwy 131, as the highway bisects deer winter range and traffic volumes continue to increase.

Habitat enhancement to counteract the lingering effect of historic cattle and sheep grazing practices and to reset vegetative succession to improve forage quality for wintering deer and elk would benefit both species. Potential treatment practices include prescribed fire,

mechanical removal or thinning of pinyon-juniper woodland, timber and beetle-kill management, mechanical mastication or roller-chopping of mountain shrub communities, understory restoration, and management/restoration of the soil water table and wet meadow/seep areas.

Current Conservation Efforts

CPW participates with the BLM, the USFS, and local governments, as appropriate, to evaluate and comment on land use proposals, including the application of timing limitations, identification of best management practices, and development of mitigation proposals. As a cooperating agency on the BLM RMPA to conserve big game habitat and migration corridors, CPW will work with BLM to identify threats to big game populations and develop appropriate conservation actions to sustain big game herds in Colorado.

CPW also partners with BLM, USFS and others to conduct habitat management projects in the priority area to improve habitat for greater sage-grouse and big game. Projects completed by BLM within the priority landscape over the last several years include wet meadow enhancements to reduce erosion and improve forage quality, removal of several miles of woven and barbed wire fence to reduce barriers to ungulate movement, vegetation projects such as pinyon-juniper hand and mastication treatments (approximately 2000 acres), pond development and virtual fence installation. Since 2020, the USFS has also conducted multiple pinyon-juniper hand thinning and mastication projects (750 acres) and fence removal projects. Several partners provided funding and labor support towards the projects.

CPW and CDOT recently completed the WSWPS; a limited number of segments along I-70 between Eagle and Gypsum and west of Dotsero were identified in the top 5% of highway segments in need of mitigation. CDOT is currently working on a couple projects near the town of Vail. Design is complete on a project to replace and increase the length of the exclusion fence near the Dowd Junction box culvert. CDOT completed design to add six wildlife underpasses along I-70 between the town of Vail and Vail Pass. The construction of a large and a medium sized underpass designed for elk and deer passage, in addition to four smaller underpasses for species such as lynx, bear and mountain lion is planned to begin in 2024. The project will include approximately ten miles of wildlife exclusion fence; this fence will tie into 5 existing large span-bridges, making for a total of 11 crossing structures from the town of Vail to the top of Vail Pass. This will be the first comprehensive crossing structure project completed on I-70 in Colorado. There was also an interagency group led by Eagle County to assess highway safety and wildlife permeability needs in the county. One of the priority areas they identified is along CO Hwy 131 south of State Bridge.

Cost of Conservation Actions

Protection of winter range and migration corridors on private lands through conservation easements or fee title acquisition would be an effective method of ensuring long-term conservation of non-federal land habitat. However, CPW has not completed any conservation easements in the Piney River/State Bridge priority area because of the lack of feasibility due to the high cost of land.

Highway crossing structures are similarly expensive especially when improving permeability for ungulates across a four to six lane interstate in mountainous terrain. The cost per structure could run in the tens of millions of dollars.

Habitat enhancement may be a more feasible action; however the average cost for pinyon-juniper removal or understory restoration habitat treatments is approximately \$250/acre. Therefore, habitat enhancement of 5,000 acres (approximately 4% of winter range in the priority area) would cost a minimum of \$1,250,000.

#5 Colorado Landscape Priority Area: Book Cliffs (West-Central Colorado)

The Book Cliffs landscape priority area includes all of the Book Cliffs deer herd (DAU D-11) and western portions of the Yellow Creek elk herd (DAU E-10) within 1,757 square miles. The priority area provides habitat for approximately 8,300 mule deer and perhaps 6,000 elk. Specifically, the priority area includes GMUs 21 and 30. Much of GMU 21 and northern portions of GMU 30 are public land managed by the BLM. The Book Cliffs deer herd is below the long-term population objective established by CPW. The elk population is above the current long-term objective, but elk populations on public land portions of the priority area are frequently lower than desired. Both species migrate in elevation in both the fall and spring. BLM lands provide important winter range for both species, and portions of each herd also migrate relatively long distances annually, including movement into the state of Utah for the winter months. Habitat carrying capacity has declined over recent decades, as both quantity and quality of habitat have diminished due to extensive oil and gas development, fragmentation by roads and trails, increased human activity on public lands, drought and suppression of large-scale wildfires.

Spatial Location

The Book Cliffs priority area is located in west-central Colorado. It lies to the northwest of Grand Junction along the Colorado-Utah state line (Figure 5.1). It is bounded on the north by the White River, on the south by the Colorado River, and on the east by the high ground of the Cathedral Rim. The priority area occurs in Mesa, Garfield and Rio Blanco counties.

The Book Cliffs priority area contains approximately 1,150 square miles of suitable winter range (Figure 5.2). Lower elevation lands across the priority area comprise the most important winter range for both deer and elk. Favorable snow depths, slope and aspect, and winter temperatures create accessible forage and make these areas suitable for wintering big game. Elk are generally found at higher elevations than deer due to their ability to forage in deeper snow conditions. However, during severe winters, both deer and elk are forced to winter at the lower elevations. The majority of deer and elk in the priority area winter on public lands, as approximately 91% of the winter range occurs on public land. The remaining 9% of the winter range is held by private landowners. Important private land wintering areas are found within the lower drainages.

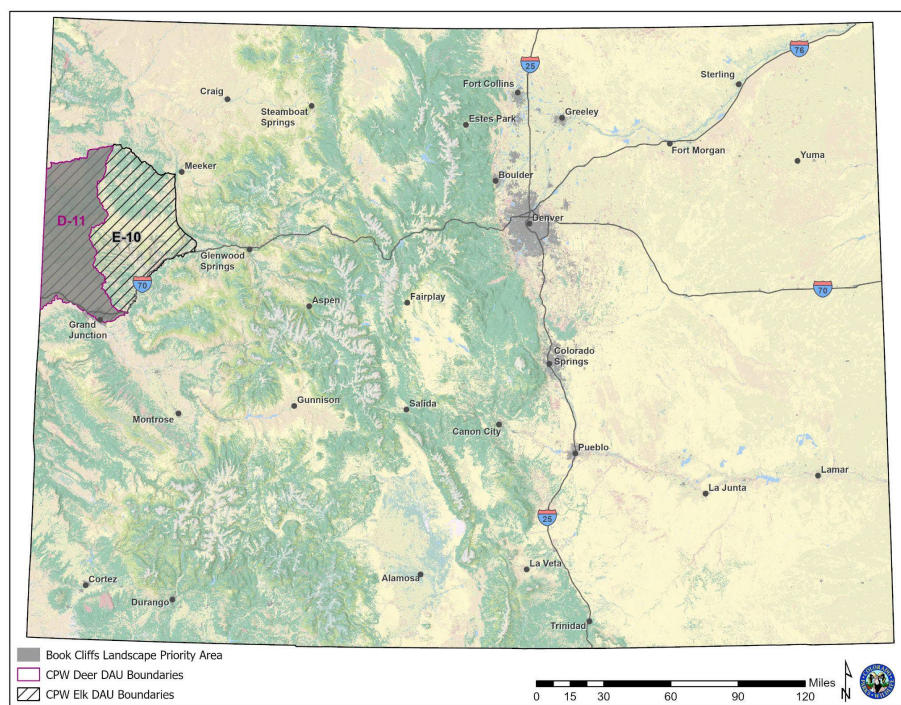


Figure 5.1. Location of the Book Cliffs landscape priority area in northwestern Colorado. The area encompasses all of mule deer DAU D-11 and the western portion of elk DAU E-10.

Habitat Types

Topography varies greatly in the Book Cliffs priority area. The highest elevations are at the center of the area at the top of the Book Cliffs. Elevations decrease to the north and south from there. The highest elevation in the priority area is approximately 9,300 ft. The lowest elevation is approximately 4,600 ft and occurs in the southwestern corner of the priority area, where the Colorado River meets the Utah state line. The Book Cliffs area is noted for canyon country in the south and rolling pinyon-juniper, sagebrush, and mountain shrub steppe in the north.

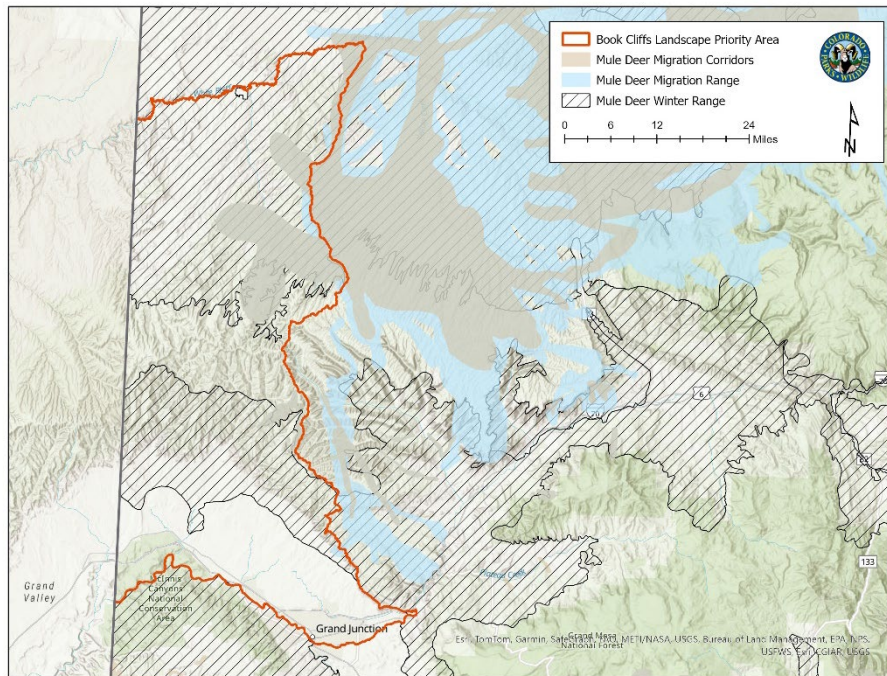


Figure 5.2. CPW Species Activity Map data of mule deer winter range, migration corridors and migration range for the Book Cliffs herd (D-11) herd. Migration corridors are high-use migration areas derived from BBMM with staff review and edits.

Steep-sided sandstone and shale canyons are dominant geographic features of this priority area. The Book Cliffs are a generally continuous, uniformly high cliff formation with canyons and washes running north to south toward the Colorado River. In the upper reaches of GMU 30, large canyons bisect the topography at frequent intervals. The interior

Vegetation within the Book Cliffs priority area varies across the wide range of elevations and aspects that occur. At lower elevations along drainages, irrigated lands composed primarily of grass/alfalfa meadows are common. At lower elevations away from the drainages, vegetation is typical of most semi-arid regions in western Colorado. Saltbush, sagebrush, and greasewood are common shrub species found in these open desert areas. Cheatgrass dominates the understory in many areas in the desert. Pinyon-juniper woodlands are common on the lower and intermediate slopes throughout the priority area. Gambel oak is found mixed with pinyon-juniper woodland at higher elevations. A combination of sagebrush and snowberry are commonly found in open areas in the Gambel oak zone at intermediate and higher elevations. Higher elevations are dominated by aspen and Douglas fir, sagebrush steppe, and serviceberry-dominated shrublands. Vegetative communities grade into each other in response to slope, aspect, and moisture, forming a mosaic pattern across the landscape. Extensive crop production of corn, wheat, alfalfa, beans, and onions occurs in the Grand Valley. These crop fields are used by deer and elk principally during the winter months, although some deer use the fields throughout the year.

Migration and Movements

GPS collared data specific migration corridors in the Book Cliffs priority area have not yet been identified due to insufficient sampling. Migration corridors are mapped during the SAM session using survey data and observational information from local staff (Figure 5. 2). Two principal migration corridors are known to exist. A portion of deer and elk move to the south side of the priority area and winter on the Book Cliffs slopes above the valley floor, or drop into the valley, depending on winter conditions. This tends to be a relatively short-distance movement pattern. On the north side of the priority area, similar movements in elevation between summer and winter range occur, but a portion of the deer and elk demonstrate longer-distance, directional seasonal migration. This movement pattern is to the west and northwest, with a significant proportion of both deer and elk wintering on adjacent areas in Utah.

Landownership

The Book Cliffs priority area contains a mixture of public and private lands. Approximately 81% of the priority area is in public ownership. The vast majority of the priority area (80% or 905,000 acres) is managed by the BLM, 0.4% is managed by CPW, 0.2% is managed by the SLB and 19% is privately owned (Figure 5.3). BLM lands in the priority area are managed by the Grand Junction and White River Field Offices, located in Grand Junction and Meeker, respectively. The land managed by CPW falls within the Square S Summer Range tract of the Piceance State Wildlife Area.

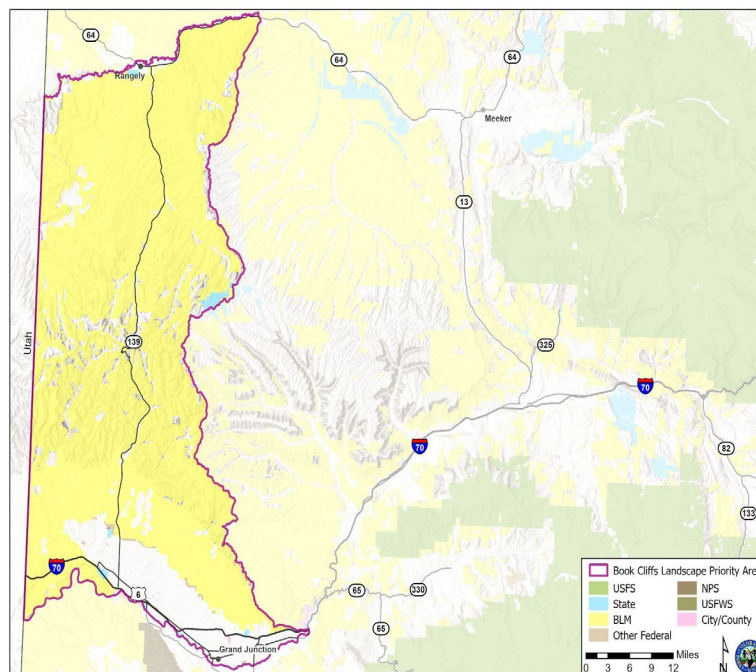


Figure 5.3. Surface landownership in the Book Cliffs (D-11) landscape priority area.

Land Uses

Livestock production is a predominant land use throughout the priority area. Much of the private land is used to graze livestock throughout the year. Cattle and sheep graze on BLM lands during various seasons of the year. Livestock are generally grazed on allotments during the summer and then moved to home ranches for the winter, but some grazing also occurs on BLM lands during the winter months. Most domestic grazing is by cattle. Historically, domestic sheep were grazed in significant numbers, but are now limited to a few small flocks.

Crop production is limited to specific regions within southern portions of the priority area, but plays a significant role in wildlife management. The Grand Valley area around Grand Junction and Fruita is extensively irrigated and farmed.

Significant oil and natural gas resources underlie portions of the Book Cliffs landscape priority area, particularly in the northern half of the area. Extensive development has occurred in the Douglas Creek drainage basin. While the field remains in production, the pace of development has fallen sharply since 2009. An increase in the price of natural gas could accelerate these activities.

The Book Cliffs priority area experienced a great deal of human population growth over the past 20 years, primarily in the Grand Valley and along I-70. The majority of new housing developments built outside city limits have occurred in deer winter range, fragmenting former sagebrush and agricultural lands. The area north of Grand Junction is undergoing rapid conversion of agricultural lands to exurban and suburban housing developments.

Outdoor recreation is extensive across the priority area, which provides excellent backcountry hiking, biking, and OHV opportunities. Vehicular access varies across private and public lands. A network of roads provides ample access to many areas that are open to multi-purpose land uses. Big game hunting is a major recreational activity in the priority area in the fall. Fishing is limited to some of the larger perennial streams and to several public and private reservoirs.

Commercial timber harvest is limited to small blocks and occurs primarily on private land. Some Douglas fir has been harvested in recent years. Most of this harvest occurs in rugged canyon areas in the northern part of the priority area. Aspen has also been harvested, sometimes as part of other land management practices including habitat management for big game wildlife. Some firewood is harvested, both commercially and privately.

Risk/Threats

Livestock grazing is extensive across the Book Cliffs priority area. The arid nature of the priority area requires careful management to ensure that livestock grazing is done in a

manner consistent with maintaining land health standards. Vegetation in the priority area, particularly within deer range, has been intensively managed to produce livestock forage, often to the detriment of shrubs important as deer winter forage. Natural fire has been suppressed in the priority area for many decades, and pinyon-juniper encroachment into sagebrush communities is a significant concern in some areas. Pinyon-juniper encroachment may be impacting wildlife populations by reducing palatable forage suitable for deer.

There are no designated BLM Herd Management Areas managed for feral horses in the area, but hundreds of feral horses have been documented there. The BLM has conducted horse round-ups over the last few years, including an attempt to remove horses from the West Douglas Creek area in 2023. The areas used by horses overlap with mule deer and elk winter range, winter concentration areas, and severe winter range. These areas are critical to the sustainability and resilience of these wild ungulate herds and the high levels of non-designated horse use contribute directly to habitat degradation in the Book Cliffs.

Intensity of outdoor recreation activity is increasing in the priority area. Fruita has become a destination mountain biking area where new trail complexes have been pioneered in recent years. Off road vehicle activity on federal lands has also increased substantially.

Oil and gas production is currently at a relatively low level but could increase quickly with a change in the market price of natural gas. Oil and gas developments can affect big game wildlife in several ways. One is the direct disturbance on and immediately surrounding drill pads due to development and production activities on the drill pad, increased human activity, and habitat displacement. Indirect disturbance effects also extend into adjacent undeveloped areas and can alter deer use patterns in these habitats. Additionally, the necessary infrastructure to support oil and gas production, including roads and pipelines, fragment the landscape and contribute to an overall decline in habitat quality. Elk and deer tend to avoid areas of higher human activity, and thus can lose access to affected habitat. Both summer and winter ranges have been affected by past and present oil and gas development and production. Planned developments will likely be concentrated more heavily on winter ranges, increasing the impact of each development on wintering deer and elk.

While impacts from renewable development are still being assessed, it is worth noting that the same landscape characteristics that often make sites suitable for solar facility siting, in particular (e.g., flat, unforested areas with southern exposures), contribute to landscape functionality as winter habitat and movement routes for big game species. Due to current federal requirements for security fencing to protect solar infrastructure, the installation of large-scale solar projects typically result in a complete loss of habitat for big game and other wildlife species, and can preclude occupancy, movement and habitat restoration efforts for decades.

Increasing suburban and exurban residential development has occurred in some of the most productive habitat (irrigated agricultural fields) in the priority area. The resulting loss of deer and elk winter range is a significant and increasing concern.

CO Hwy 139 bisects the priority area, but has not been identified as a major risk factor for wildlife-vehicle collisions.

Increased recreation activities and suburban/exurban development are immediate threats in the Book Cliffs priority area. Vegetative effects of livestock grazing and effects of oil and gas development and production are long-term threats, so long as current energy market conditions prevail. In addition, the prevalence of chronic wasting disease from harvest data in GMU 21 and GMU 30 is estimated at less than 5% for deer and elk.

Conservation Actions

Several actions may be successful in reducing or eliminating these threats. First and foremost, continued diligence from the BLM in avoiding, minimizing, and mitigating the negative effects of land use developments, including recreation, on migrating and wintering deer and elk will be of critical importance. It is important for CPW to collaborate with land managers, industry and local governments to develop best practices to minimize impacts to wildlife and habitats from future solar development. Counties, municipalities, and non-governmental organizations also have a role to play in properly designing and implementing land use practices within the priority area. Limitation of the timing and intensity of recreational activity on publicly and privately owned winter range will be especially valuable.

Although private lands make up a small portion of the Book Cliffs landscape priority area, they constitute some of the most productive habitat. Protection of privately owned migration areas and winter ranges through conservation easements could benefit conservation of deer and elk in the priority area. Land value in the priority area is lower than in some of the mountain communities, and may help in leveraging conservation easement efforts.

Habitat enhancement to counteract the vegetative effects of domestic livestock grazing practices and to reset vegetative succession to improve forage quality for wintering deer and elk would benefit both species. Potential treatment practices include prescribed fire, mechanical removal or thinning of pinyon-juniper woodland, mechanical mastication or roller-chopping of mountain shrub communities, understory restoration, and management/restoration of the soil, water table and wet meadow/seep areas.

CPW is conducting a Western Slope Mountain Lion Density Study to better understand lion populations across the western slope of Colorado. This will help CPW make more informed management decisions based on science. The study started in 2021 in Middle Park in the

Northwest Region and in 2022 in the Gunnison area within the Southwest Region. The Middle Park study concluded in early 2023 and the northwest study will be moved to the Book Cliffs area during the winter of 2023-2024. The study will run for two years.

Current Conservation Efforts

CPW participates with the BLM and local governments, as appropriate, to evaluate and comment on land use proposals, including the application of timing limitations, identification of best management practices and development of mitigation proposals. CPW has also partnered with BLM and others to conduct habitat management projects in the priority area, particularly in the higher elevations along the eastern edge of the area. Most of these projects have involved the mechanical removal of pinyon-juniper woodland. CPW and CDOT have established a transportation alliance to coordinate efforts to reduce wildlife-vehicle collisions and to increase permeability across state highway corridors. At this time there are no statewide priority highway segments identified within the Book Cliffs landscape, however that does not preclude local efforts and actions from occurring.

Cost of Conservation Actions

Protection of winter range and migration corridors on private lands through conservation easements would be an effective method of ensuring long-term conservation of non-federal habitat. CPW has not completed any conservation easements in the priority area to date. Even with the relatively moderate cost of land in the area, purchased easements will be quite expensive. A single easement of sufficient size to be meaningful will cost several million dollars, depending on location and easement terms.

Habitat enhancement may be a more feasible action; however the average cost for pinyon-juniper removal or understory restoration habitat treatments is approximately \$250/acre. Therefore, habitat enhancement of 5000 acres (approximately 4% of winter range in the priority area) would cost a minimum of \$1,250,000.

APPENDIX A: Department of the Interior Secretarial Order 3362: Improving Habitat Quality in Western Big-Game Winter Range and Migration Corridors

ORDER NO. 3362

Subject: Improving Habitat Quality in Western Big-Game Winter Range and Migration Corridors

Sec. 1 Purpose. This Order directs appropriate bureaus within the Department of the Interior (Department) to work in close partnership with the states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming to enhance and improve the quality of big-game winter range and migration corridor habitat on Federal lands under the management jurisdiction of this Department in a way that recognizes state authority to conserve and manage big-game species and respects private property rights. Through scientific endeavors and land management actions, wildlife such as Rocky Mountain Elk (elk), Mule Deer (deer), Pronghorn Antelope (pronghorn), and a host of other species will benefit. Additionally, this Order seeks to expand opportunities for big-game hunting by improving priority habitats to assist states in their efforts to increase and maintain sustainable big game populations across western states.

Sec. 2 Authorities. This Order is issued under the authority of section 2 of Reorganization Plan No. 3 of 1950 (64 Stat. 1262), as amended, as well as the Department's land and resource management authorities, including the following:

- a. Federal Land Policy and Management Act of 1976, as amended, 43 U.S.C. 1701, *et seq.*;
- b. U.S. Geological Survey Organic Act, as amended, 43 U.S.C. 31, *et seq.*;
- c. National Wildlife Refuge System Improvement Act of 1997, as amended, 16 U.S.C. 668dd *et seq.*; and
- d. National Park Service Organic Act of 1916, as amended, 54 U.S.C. 100101, *et seq.*

Sec. 3 Background. The West was officially “settled” long ago, but land use changes continue to occur throughout the western landscape today. Human populations grow at increasing rates with population movements from east and west coast states into the interior West. In many areas, development to accommodate the expanding population has occurred in important winter habitat and migration corridors for elk, deer, and pronghorn. Additionally, changes have occurred across large swaths of land not impacted by residential development. The habitat quality and value of these areas crucial to western big-game populations are often degraded or declining.

The Bureau of Land Management (BLM) is the largest land manager in the United States (U.S.) with more than 245 million acres of public land under its purview, much of which is found in Western States. The U.S. Fish and Wildlife Service (FWS) and National Park Service (NPS) also manage a considerable amount of public land on behalf of the American people in the West. Beyond land management responsibilities, the Department has strong scientific capabilities in the U.S. Geological Survey (USGS) that can be deployed to assist State wildlife agencies and Federal land managers. Collectively, the appropriate bureaus within the Department have an opportunity to serve in a leadership role and take the initiative to work closely with Western States on their priorities and objectives as they relate to big-game winter range and migration corridors on lands managed by the Department.

Consistent with the American conservation ethic, ultimately it is crucial that the Department take action to harmonize State fish and game management and Federal land management of big-game winter range and corridors. On lands within these important areas, if landowners are interested and willing, conservation may occur through voluntary agreements.

Robust and sustainable elk, deer, and pronghorn populations contribute greatly to the economy and well-being of communities across the West. In fact, hunters and tourists travel to Western States from across our Nation and beyond to pursue and enjoy this wildlife. In doing so, they spend billions of dollars at large and small businesses that are crucial to State and local economies. We have a responsibility as a Department with large landholdings to be a collaborative neighbor and steward of the resources held in trust.

Accordingly, the Department will work with our State partners and others to conserve and/or improve priority western big-game winter range and migration corridors in sagebrush ecosystems and in other ecotypes as necessary. This Order focuses on the Western States of: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. These States generally have expansive public lands with established sagebrush landscapes along with robust big-game herds that are highly valued by hunters and tourists throughout the Nation.

The Department has broad responsibilities to manage Federal lands, waters, and resources for public benefit, including managing habitat to support fish, wildlife, and other resources. Secretary's Order 3356, "Hunting, Fishing, Recreational Shooting, and Wildlife Conservation Opportunities and Coordination with States, Tribes, and Territories," (SO 3356) was issued on September 15, 2017. SO 3356 primarily focused on physical access to lands for recreational activities, particularly hunting and fishing. This Order is focused on providing access to big game animals by providing direction regarding land management actions to improve habitat quality for big-game populations that could help ensure robust big-game populations continue to exist. Further, SO 3356 includes a number of directives related to working with States and using the best available science to inform development of guidelines, including directing relevant bureaus to:

- a. Collaborate with State, tribal, and territorial fish and wildlife agencies to attain or sustain State, tribal, and territorial wildlife population goals during the Department's land management planning and implementation, including prioritizing active habitat management projects and funding that contributes to achieving wildlife population

objectives, particularly for wildlife that is hunted or fished, and identifying additional ways to include or delegate to States habitat management work on Federal lands;

b. Work cooperatively with State, tribal, and territorial wildlife agencies to enhance State, tribe, and territorial access to the Department's lands for wildlife management actions;

c. Within 180 days, develop a proposed categorical exclusion for proposed projects that utilize common practices solely intended to enhance or restore habitat for species such as sage grouse and/or mule deer; and

d. Review and use the best available science to inform development of specific guidelines for the Department's lands and waters related to planning and developing energy, transmission, or other relevant projects to avoid or minimize potential negative impacts on wildlife.

This Order follows the intent and purpose of SO 3356 and expands and enhances the specific directives therein.

Sec. 4 Implementation. Consistent with governing laws, regulations, and principles of responsible public stewardship, I direct the following actions:

a. With respect to activities at the national level, I hereby direct the BLM, FWS, and NPS to:

(1) Within 30 days, identify an individual to serve as the "Coordinator" for the Department. The Coordinator will work closely with appropriate States, Federal agencies, nongovernmental organizations, and/or associations to identify active programs focused on big- game winter range and/or migration corridors. The programs are to be organized and cataloged by region and other geographic features (such as watersheds and principles of wildlife management) as determined by the Deputy Secretary, including those principles identified in the Department's reorganization plan.

(2) Within 45 days, provide the Coordinator information regarding:

(i) Past and current bureau conservation/restoration efforts on winter range and migration corridors;

(ii) Whether consideration of winter range and corridors is included in appropriate bureau land (or site) management plans;

(iii) Bureau management actions used to accomplish habitat objectives in these areas;

(iv) The location of areas that have been identified as a priority for conservation and habitat treatments; and (v) Funding sources previously used and/or currently available to the bureau for winter range and migration corridor conservation/restoration efforts.

(3) Within 60 days, if sufficient land use plans are already established that are consistent with this Order, work with the Coordinator and each regional Liaison (see section 4b) to discuss implementation of the plans. If land use plans are not already established, work with the Coordinator and each regional Liaison to

develop an Action Plan that summarizes information collected in section 4 (a) (1) and (2), establishes a clear direction forward with each State, and includes:

- (i) Habitat management goals and associated actions as they are associated with big game winter range and migration corridors;
- (ii) Measurable outcomes; and
- (iii) Budgets necessary to complete respective action(s).

b. With respect to activities at the State level, I hereby direct the BLM, FWS, and NPS to:

(1) Within 60 days, identify one person in each appropriate unified region (see section 4a) to serve as the Liaison for the Department for that unified region. The Liaison will coordinate at the State level with each State in their region, as well as with the Liaison for any other regions within the State. The Liaison will schedule a meeting with the respective State fish and wildlife agency to assess where and how the Department can work in close partnership with the State on priority winter range and migration corridor conservation.

(2) Within 60 days, if this focus is not already included in respective land management plans, evaluate how land under each bureau's management responsibility can contribute to State or other efforts to improve the quality and condition of priority big-game winter and migration corridor habitat.

(3) Provide a report on October 1, 2018, and at the end of each fiscal year thereafter, that details how respective bureau field offices, refuges, or parks cooperated and collaborated with the appropriate State wildlife agencies to further winter range and migration corridor habitat conservation.

(4) Assess State wildlife agency data regarding wildlife migrations early in the planning process for land use plans and significant project-level actions that bureaus develop; and

(5) Evaluate and appropriately apply site-specific management activities, as identified in State land use plans, site-specific plans, or the Action Plan (described above), that conserve or restore habitat necessary to sustain local and regional big-game populations through measures that may include one or more of the following: (i) restoring degraded winter range and migration corridors by removing encroaching trees from sagebrush ecosystems, rehabilitating areas damaged by fire, or treating exotic/invasive vegetation to improve the quality and value of these areas to big game and other wildlife;

(ii) revising wild horse and burro-appropriate management levels (AML) or removing horses and burros exceeding established AML from winter range or migration corridors if habitat is degraded as a result of their presence;

(iii) working cooperatively with private landowners and State highway departments to achieve permissive fencing measures, including potentially modifying (via smooth wire), removing (if no longer necessary), or seasonally

adapting (seasonal lay down) fencing if proven to impede movement of big game through migration corridors;

- (iv) avoiding development in the most crucial winter range or migration corridors during sensitive seasons;
- (v) minimizing development that would fragment winter range and primary migration corridors;
- (vi) limiting disturbance of big game on winter range; and
- (vii) utilizing other proven actions necessary to conserve and/or restore the vital big-game winter range and migration corridors across the West.

c. With respect to science, I hereby direct the USGS to:

(1) Proceed in close cooperation with the States, in particular the Western Association of Fish and Wildlife Agencies and its program manager for the Crucial Habitat Assessment Tool, prior to developing maps or mapping tools related to elk, deer, or pronghorn movement or land use; and

(2) Prioritize evaluations of the effectiveness of habitat treatments in sagebrush communities, as requested by States or land management bureaus, and identified needs related to developing a greater understanding of locations used as winter range or migration corridors.

d. I further hereby direct the responsible bureaus and offices within the Department to:

(1) Within 180 days, to update all existing regulations, orders, guidance documents, policies, instructions, manuals, directives, notices, implementing actions, and any other similar actions to be consistent with the requirements in this Order;

(2) Within 30 days, provide direction at the state or other appropriate level to revise existing Federal-State memorandums of agreement to incorporate consultation with State agencies on the location and conservation needs of winter range and migration routes; and (3) Consult with State wildlife agencies and bureaus to ensure land use plans are consistent and complementary to one another along the entire wildlife corridor in common instances where winter range or migration corridors span jurisdictional boundaries.

e. Heads of relevant bureaus will ensure that appropriate members of the Senior Executive Service under their purview include a performance standard in their respective current or future performance plan that specifically implements the applicable actions identified in this Order.

Sec. 5 Management. I hereby direct the Deputy Secretary to take is responsible for taking all reasonably necessary steps to implement this Order.

Sec. 6 Effect of Order. This Order is intended to improve the internal management of the Department. This Order and any resulting reports or recommendations are not intended to, and do not create any right or benefit, substantive or procedural, enforceable at law or equity by a party against the United States, its departments, agencies, instrumentalities or entities, its officers or employees, or any other person. To the extent there is any inconsistency between the provision of this Order and any Federal laws or regulations, the laws or regulations will control.

Sec. 7 Expiration Date. This Order is effective immediately. It will remain in effect until its provisions are implemented and completed, or until it is amended, superseded, or revoked.

Secretary of the Interior

Date:

**APPENDIX B: Examining the Timing, Extent, and Distribution of Mule Deer Migration
in the North Park Deer Herd, Colorado, USA**

Examining the Timing, Extent, and Distribution of Mule Deer Migration in the North Park Deer Herd, Colorado, USA



Prepared and Submitted by Eric VanNatta on August 30, 2024

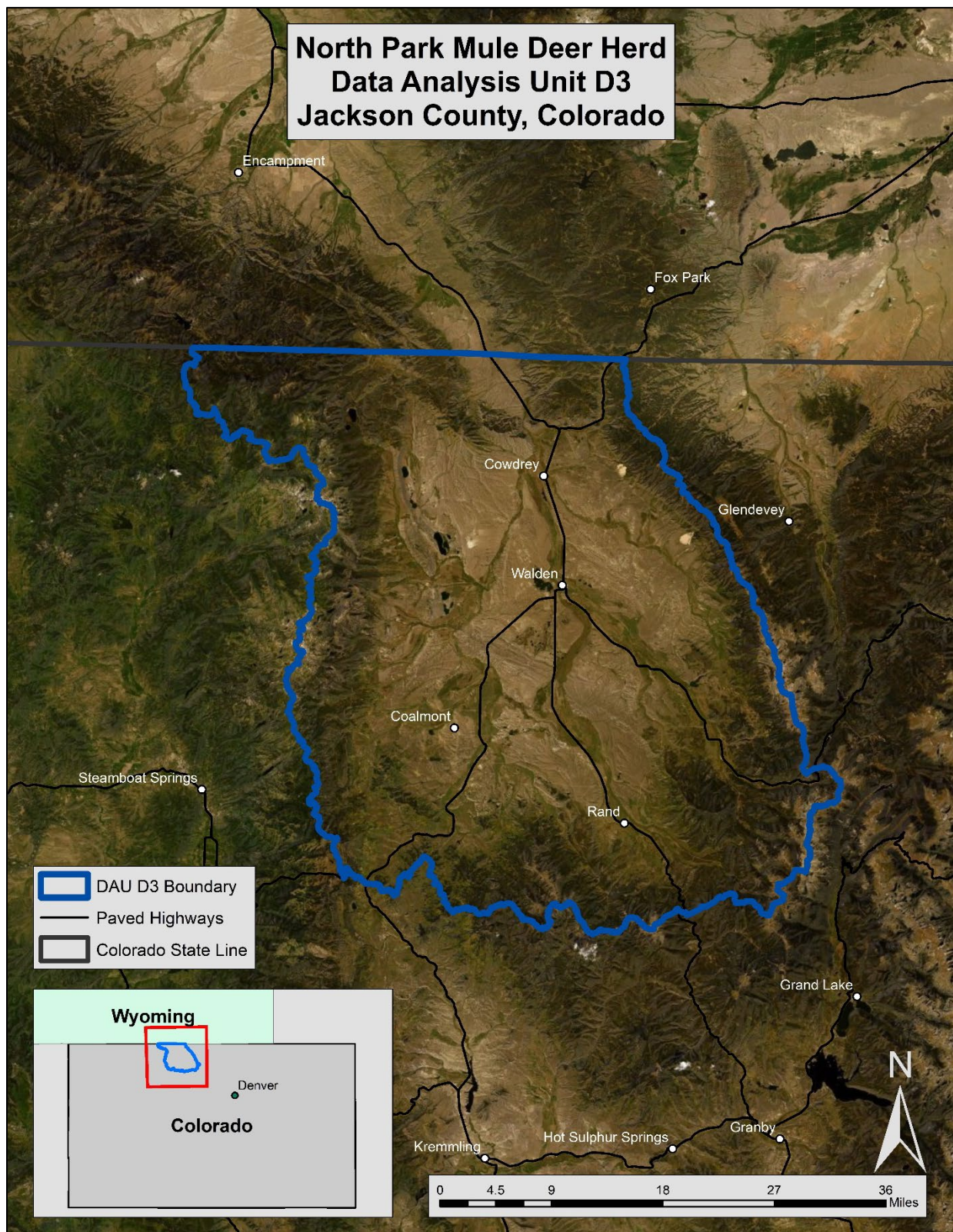
Terrestrial Biologist - Colorado Parks and Wildlife - Steamboat Springs, Colorado

Funded by U.S. Department of the Interior Secretarial Order 3362: Improving Habitat Quality in Western Big-Game Winter Range and Migration Corridors

Project: F19AP00246

TABLE OF CONTENTS

| | |
|---|----|
| Map of North Park Deer Herd (Data Analysis Unit D3) | 2 |
| Introduction | 3 |
| Methods | |
| Deer Captures | 4 |
| Data Analysis | 4 |
| Results | |
| Deer Captures and Data Collection | 5 |
| Timing of Migrations | 5 |
| Extent of Migrations | 5 |
| Distribution of Migration Corridors and Stopover Areas..... | 6 |
| Discussion & Management Implications | |
| Deer Migrations and Classification Flights | 6 |
| Current Extent of D3 Winter Ranges | 7 |
| Shifts in Historic Winter Range Use | 7 |
| CWD Management Implications | 8 |
| Risk of Vehicle Collisions | 8 |
| Summary | 9 |
| Acknowledgements | 10 |
| Appendix I | |
| Figures | 11 |
| Literature Cited | 22 |



INTRODUCTION

The North Park Mule Deer Herd, located in North Central Colorado and encompassing all of Jackson County, also referred to as North Park, constitutes Data Analysis Unit-D3 (DAU-D3; Colorado Parks and Wildlife 2023). North Park is an intermountain basin situated on the east side of the Continental Divide with elevations ranging from approximately 7,800 to 13,000 feet. North Park's wide range of elevation fosters a diversity of habitat, from expansive sagebrush communities on the basin floor to evergreen and aspen forests above 8,500', transitioning to alpine tundra above 11,000'. Serving as the headwaters of the North Platte River, North Park contains many significant drainages including Grizzly Creek, the Illinois River, the Michigan River, the Canadian River, and the North Fork of the North Platte River. North Park is geographically bounded to the north by the Wyoming state line, to the east by the Medicine Bow and Never Summer Ranges, to the south by the Rabbit Ears Range, and to the west by the Park Range. North Park spans 1.04 million acres (1,618 square miles) and features diverse land ownership including 35.9% private land, 31.9% USFS, 18.2% BLM, 12% State of Colorado, and 1.7% USFWS (Arapaho National Wildlife Refuge). North Park also includes portions of the Mt. Zirkel, Platte River, Rawah, Neota, and Never Summer Wilderness Areas.

During summer months, deer are dispersed throughout the entire DAU, although higher densities are often observed on the periphery of the park, particularly in forested and alpine habitats above 8,500 feet. Population estimates have fluctuated over time with as many as 10,000 – 12,000 deer in 1950's (Don Gore, Colorado Division of Wildlife, unpublished report), although more recent estimates suggest approximately 4,500 – 6,000 deer (2023 post-hunt estimate: 4,600 deer). Historically, North Park harbored a substantial wintering deer population with a considerable number of animals utilizing winter range throughout the DAU. However, over recent decades, Colorado Parks and Wildlife (CPW) staff observations indicate a shift in wintering deer patterns, with the majority of deer now migrating from North Park to adjacent winter ranges north, east, and south of the DAU. Staff hypothesize this shift in winter deer distribution may be a result of past management structures implemented during the mid-1900's, where a combination of relatively liberal hunting quotas and late season structures permitted years of heavy, targeted harvest of deer on this winter range. During this management regime, staff hypothesize that a smaller, migratory subset of this population less affected by hunter harvest may have become the dominant cohort in this population. Today, despite only moderate land use changes, including the conversion of some sage habitat to grassland for livestock grazing, CPW staff believe North Park still retains quality mule deer winter range. However, anecdotal evidence from landowners and staff alike suggest very few deer, if any, utilize this habitat throughout winter.

Due to the migratory behavior of D3 mule deer today, managing for stable population and sex ratio objectives is challenging. For instance, CPW classification flights, conducted each year in late December or early January, coincide with winter conditions that drive deer, elk, and moose into areas with greater sightability (i.e. onto winter range). However, by this time most mule deer appear to have already left North Park or are found near staging areas along suspected migration routes. Over the past decade, an average of 250 deer have been observed each year during these surveys, contrasting sharply with reports of 2,000 – 3,000 from the 1960's - 1970's. Smaller sample sizes from current survey efforts account for approximately 5% of the total herd. Complications arise when using these classification data for population modeling as low sample sizes produce larger confidence intervals for age and sex ratios, two primary metrics used for estimating population size. Consequently, CPW's ability to accurately estimate population size and detect subtle demographic changes is limited.

While some information regarding mule deer migration activity in D3 is available, a more comprehensive understanding of these migrations would be valuable for wildlife managers. Previous telemetry studies conducted by CPW in 2003 revealed that many deer in D3 migrated bi-directionally out of North Park, either north to Wyoming or south to Middle Park, Colorado. Subsequent telemetry data collected from Wyoming Game and Fish Department in the Platte Valley and CPW in Middle Park corroborated similar movements among deer captured on these winter ranges. However, data from these studies were either too coarse to discern specific movement corridors and evaluate migration timing (i.e. weekly VHF locations), or sample sizes were insufficient to confidently assess proportions of deer utilizing these winter ranges. Higher-resolution data documenting migration timing relative to winter classification flights, evaluating the proportion of deer utilizing different winter ranges, and identifying specific migration corridors and stop-over areas are lacking.

To address these knowledge gaps, our study aimed to collect more information on mule deer movements using GPS collars with fix rates sufficient to examine migration characteristics. We monitored adult female mule deer from 2021 through 2023 to quantify the timing and duration of migration, distance and direction of travel, and delineate migration corridors and stopover areas. This information may aid CPW staff in assessing the efficacy of current management practices and to identify and conserve critical mule deer habitat. Additionally, such information may assist wildlife managers in assessing the reliability of population estimates, directing management for reducing Chronic Wasting Disease (CWD) prevalence, and identifying roadways at higher risk for deer-vehicle collisions. Data from this study may also serve as a more robust baseline for future assessments of North Park mule deer migration.

METHODS

Deer Captures

We utilized a combination of ground darting and aerial net gunning methods to capture adult female mule deer occupying summer range in D3. During the fall of 2021, we employed ground darting techniques to capture deer between dusk and dawn along rural roadways, as this proved to be the most efficient method for locating and capturing deer. Using extensive road systems across the DAU also facilitated a broad distribution of collars across summer range. We remotely immobilized deer by administering 1.3cc of a combination of butorphanol, azaperone, and medetomidine (BAM: 0.43 mg/kg butorphanol, 0.36 mg/kg azaperone, 0.14 mg/kg medetomidine; Wildlife Pharmaceuticals, Inc.). Following induction, we affixed a GPS collar (Litetrack Iridium TL 330 or Litetrack 420; Lotek Wireless Inc., Newmarket, ON, Canada) programmed to record a location every 4 hours (Litetrack Iridium TL 330) or 1 hour (Litetrack Iridium 420). We ear-tagged all animals with unique identifiers and monitored vital signs in accordance with CPW ACUC Deer Handling Guidelines (ACUC Protocol# 10-2008). Upon completion, we antagonized BAM by administering 0.5cc of naltrexone and 2.6cc of atipamezole (Wildlife Pharmaceuticals, Inc.).

We conducted aerial captures using net guns in January 2022 following ground darting efforts to deploy remaining collars, and again in February 2023 to maintain our sample size after annual mortalities. All aerial captures took place in North Park.

Both ground darting and aerial net gunning methods were approved by the CPW Animal Care and Use Committee (Permit # 07-2021). We programmed GPS collars to drop off 120 weeks after deployment.

Data Analysis

To assess mule deer migrations, we analyzed three components of annual movement characteristics: timing, extent, and distribution. To assess migration timing, we defined an individual's migratory period as one day prior to departing summer range through one day after reaching winter range (vice versa for winter migration). We manually defined these periods by reviewing annual plots of squared displacement distance from summer range (Fig 1). For each individual and year, we used July 15th as the start of our migration calendar assuming all animals should be located on summer range at this time. In most cases, displacement plots were unimodal distributions with sharp ledges indicating brief periods of movement from summer to winter range, and again from winter to summer range. Using this process, we identified individual migration start and end dates, and recorded elapsed time for both fall and spring migrations.

To evaluate the extent of mule deer migrations we filtered location data for all animals retaining only locations that were recorded during migration periods (hereafter "migration sequences"). Using these migration sequences, we quantified route distances, directions, and recorded the proportion of deer from our sample using discrete winter ranges outside of North Park.

We evaluated the distribution of migration corridors and stop-over areas using the Migration Mapper shiny app developed by the Wyoming Migration Initiative at the University of Wyoming and the U.S. Geological Survey (Merkle et al. 2022, and R Development Core Team 2021). After identifying migration sequences for each individual, we fit dynamic Brownian bridge movement models (dBBMMs) for each seasonal migration completed by an individual. We elected to use dBBMMs instead of standard Brownian bridge movement models as they account for periods in time where animals decrease movement speeds at stopover areas, thus permitting estimates of motion

variance to change over time. Since we had several collars collecting locations at 4 hour fix rates and several deer completing their migrations in just a few days, we used a margin parameter of 5 and window parameter of 13, which allowed us to calculate corridor footprints for nearly all of our observed deer migrations (large gaps in data or small datasets present challenges with larger margins and windows). Additionally, we calculated utilization distributions (UDs) for each migration sequence to identify discrete areas of disproportionately higher use. We then merged individual corridor footprints and UD's first by year, then individual, producing a single migration corridor map and UD from our sampled individuals.

RESULTS

Deer Captures and Data Collection

From August 15th, 2021 to February 4th, 2023 we captured a total of 50 mule deer using a combination of ground darting and aerial net gunning methods. Specifically, we captured 26 deer via ground darting in the fall of 2021, 15 deer via aerial captures in January 2022, and 9 deer via aerial captures in February 2023. After filtering out erroneous locations (i.e. movement speeds > 15km/hr., or DOP estimates > 4.0) and large gaps in data due to GPS collar failures or mortalities, our final dataset contained 94,100 locations, capturing 65 unique fall migrations and 47 unique spring migrations.

Timing of Migrations

Over the course of our study, we observed 65 fall migrations over three years and 47 spring migrations over two years. Sample sizes varied among these migration periods and ranged from 7 – 33 individuals. Among fall migrations, we observed 7 migration events beginning in February and March. Although these movements represented directional travel from summer range to winter range, they were separated in time from the much larger pulse of deer movement earlier in the fall. We classified these events as mid-winter movements rather than fall migrations, and excluded these movements from our fall migration timing analysis. Mid-winter movements generally occurred from the same individuals in 2022 and 2023, with a mean start date of February 27th and averaged 8 days in duration. Individuals exhibiting mid-winter movements occupied summer range along the Colorado/Wyoming boarder and traveled north short distances to winter range in Wyoming.

From 2021 through 2023, the mean fall migration period began on November 3rd. The earliest departure from summer range we documented was on September 23rd and the latest departure was on January 25th (Fig 2 top panel). Mean duration of fall migration periods was 39 days. The total range of individual fall migration periods was 2 – 132 days, with over half of migration events lasting fewer than 20 days (Fig 3). However, extended migrations were also not unusual as 18 deer (28%) spent over 60 days making their way to winter range by utilizing one or more stop over areas. Mean arrival date to winter range was December 12th. The earliest documented arrival date was October 13th and the latest arrival date was March 9th, representing a difference of nearly 21 weeks in arrival time.

From 2022 through 2023, the mean spring migration period began on April 21st (Fig 2 bottom panel). The earliest departure was documented on March 25th and the latest was on June 5th. Mean duration of spring migration periods were 33 days. The total range of individual spring migration periods was 3 – 82 days, which was notably shorter than fall migrations (Fig 3) as only 5 deer (11%) took longer than 60 days to reach summer range. The mean arrival date back to summer range was May 24th. The earliest arrival date was April 9th in 2022, and the latest arrival date was June 20th in 2023, representing a difference of approximately 10 weeks.

Extent of Migrations

Of the 112 unique migration sequences identified, we successfully determined migration pathways for 45 of our 50 individual deer. GPS collar failures and mortalities prevented us from determining migration routes for 5 deer. Out of 45 collared individuals, we determined 37 (82%) individuals migrated northward to winter range along the Platte Valley between the Colorado/Wyoming state line and Saratoga, WY, representing the primary winter range for North Park mule deer (Fig 4). Of more moderate use, we documented 5 (11%) individuals migrating southward to

winter range in Middle Park, Colorado near the town of Kremmling. We also documented 2 (4%) individuals migrating eastward into the Poudre River canyon, and 1 (2%) individual traversed Rocky Mountain National Park to winter near Estes Park, Colorado. We did not document any non-migratory deer in our study, nor did any individual spend its entire winter in North Park.

Distances of each route ranged from 10.7 mi – 76.9 mi (17.3 km – 123.8 km), with an average distance of 40.3 mi (64.8 km). A total of 10 migration routes exceeded 62 mi (100 km), where all individuals traversed nearly the entire length of North Park from summer ranges in the Park Range, Rabbit Ears Range, and Never Summer Range to winter range just east of Encampment, Wyoming. A total of 9 individuals used migratory routes shorter than 24.8 mi (40 km). Of these short distance migrants, all but one had summer home ranges on historically defined winter range near the North Sand Dunes (6 mi east of Cowdrey, CO), and typically migrated to winter range very late in the year.

Distribution of Migration Corridors and Stopover Areas

Using previously defined migration periods and sequences for each individual, we calculated dBBMMs for 62 unique fall migrations and mid-winter movements, and 42 unique spring migrations. Eight migration periods were disqualified from this analysis due to insufficient fix rates (i.e. too many gaps between fixes exceeding 13 hours). After averaging dBBMM footprints by year and then individual, we calculated contours for 1%, 2%, 5%, 10%, 15%, 20%, and 30% of the population (Fig 5). Wider corridors generally represent instances where successive locations were separated by great distances or large gaps in time, thus creating more uncertainty in estimating a precise path of travel. In contrast, narrow corridors indicate a series of successive locations collected with shorter, more consistent fix rates and with locations closer together.

We also calculated migration UD for all qualifying locations used by deer during migration periods (Fig 6). Combined by year and individual, our population UD allows for a slightly different evaluation of how mule deer use this landscape while migrating. Whereas migration corridors provide an evaluation of the geographic areas where deer travel through, they lack context on the intensity of within this footprint. As a function of the duration of time spent in an area, the UD in Figure 6 quantifies intensity of use. Areas represented in blue/green indicate places where deer traveled through with greater speed, while areas represented in orange/red indicate places of higher use, and may indicate stopover areas.

DISCUSSION AND MANAGEMENT IMPLICATIONS

Deer Migrations and Classification Flights

One significant insight from our study pertains to the timing of fall migrations, which aligns with previous field observations indicating a substantial exodus of mule deer from North Park preceding annual winter classification flights. As over half of the fall migration periods we documented began by late October, and with a mean winter range arrival date of December 12th, it is likely a sizeable proportion of D3's population is not accounted for during classification flights (Fig 2). Whether flights are conducted in early December or mid-January, our results indicated that 77% - 84% of our collared deer already began their fall migrations and 45% - 53% have already arrived on winter range outside of North Park. These results underscore the value of conducting classification flights as early as possible to survey a larger proportion of this herd.

However, it is necessary to acknowledge that our inferences are limited to female deer and more information is needed to fully understand the impacts of migration on annual classification results. Several studies in the Western U.S. have documented notable differences in migration timing between male and female deer, with males typically migrating later in the year compared to females (Rodgers et al. 2021, Kucera 1992, and Wright and Swift 1942). Researchers generally hypothesize this difference is attributed to increased energetic demands of pregnant females, who may depart earlier to mitigate potential winter nutritional deficiencies by utilizing winter forage for an extended period of time. As such, it remains unclear how observed sex ratios in December or January align with actual D3 population demographics. A replicate study assessing migration characteristics of male deer in North Park would provide valuable context when interpreting observed sex ratios and could potentially improve the accuracy of population estimates.

Current Extent of D3 Winter Ranges

Our results indicated that 82% of our collared North Park mule deer migrated into the Platte Valley along the North Platte River from the Colorado state line to highway 130 near Saratoga, Wyoming. The remaining sub herd primarily utilizes winter range in Middle Park, Colorado, with a few exceptions of small cohorts of deer migrating eastward down the Poudre River canyon or to Estes Park, Colorado. Given that the distribution of summer range for these eastward migrants lie on or near the southeastern border of North Park, it's reasonable to consider that these individuals may functionally belong to adjacent mule deer herds (i.e. D4 Red Feather/Poudre River Herd or D10 Big Thompson Herd). Given the timing and extent of these migrations, CPW staff should acknowledge that deer summering in D3 may be subject to additional harvest pressures in the Platte Valley, Middle Park (D9), and the Poudre River canyon (D4) when assessing hunting season dates, harvest quotas, and hunter distributions.

Shifts in Historic Winter Range Use

It is interesting to note that we did not observe any mule deer reside on historic winter range in North Park for the duration of winter. Historically, North Park hosted a mosaic of winter range accommodating hundreds to thousands of deer (Fig 7), with observed minimum winter counts averaging 1,900 deer annually between 1961 and 1985, peaking at over 4,000 animals in February 1961. However, from 1985 to 2023, winter observations here have dwindled, with an average of only 422 deer classified each year, never surpassing more than 1,300 animals. Despite minimal changes in land use, it appears we have witnessed a substantial shift in winter range utilization since the 1980's (Fig 8).

One hypothesis attributes this shift to overprescribed deer harvest in the mid-1900's leading to the loss of generational knowledge of traditional winter behavior. Liberal hunting opportunities during this time, including seasons extending from October through December and years where hunters could harvest multiple deer of either sex, lead to record harvests in D3 with an average annual harvest of 1,700 deer from 1947 through 1964 (Table 1). By the late 1960's, harvest began to drop off and has never since exceeded 1,000 animals. Since 2000, hunters annually harvest approximately 300 deer among all hunting seasons, which are typically conducted from September through mid-November. While it's challenging to directly credit overharvest for this shift due to methodological differences in harvest surveys and population estimates, studies on migratory ungulates have demonstrated the value of generational knowledge and learned behaviors in directing young deer where and when to migrate (Jakopak et al. 2019, and Jesmer et al. 2018). If harvest in the mid-1900's was indeed biased towards deer wintering in North Park, it's possible generational knowledge directing deer to utilize winter range in North Park was lost or damaged.

Severe weather events, or prolonged winters leading to excessive winter mortality, could have also influenced this herd in concert with high levels of harvest. The winter of 1983-1984 was noted as a severe winter and widespread deer mortality was observed across North Park. Following that winter, CPW staff have never observed more than 800 deer during winter counts. Additionally, the development of learned behaviors to avoid hunting pressure may have been another factor influencing this shift. If deer gradually learned to move further north each year to reduce the risk of human predation, similar shifts in winter deer behavior may have occurred overtime as Wyoming typically does not harvest deer beyond the month of October.

Regardless of the exact mechanism(s) that influenced winter deer behavior in D3, the question remains: will historic mule deer winter range in North Park ever be utilized again? CPW staff and North Park residents are interested in exploring opportunities to restore mule deer utilization of this historic range. Observations from staff suggest these areas still provide adequate forage quantity and quality, including large swaths of big sagebrush (*Artemisia tridentate* spp.) and antelope bitterbrush (*Purshia tridentate*), both species widely recognized as important winter forage for mule deer (Fig 9). However, formal efforts to confirm these conditions are necessary, and could inform or direct habitat restoration or improvement projects. Simultaneously, CPW staff may consider new hunting season structures to reduce harvest pressure on deer utilizing historic winter range as stopover sites by shifting hunting pressure to earlier seasons. Perhaps, though time, prioritizing and conserving the cohort of late-migrating deer may allow for some animals to remain in these areas for the duration of winter, thus gradually rebuilding a knowledge base recognizing the utility of this winter range.

Reviewing migration corridor footprints and UD's enhanced CPW's prior understanding of how deer traverse this landscape to and from winter range. Although general migration corridors have been observed through past telemetry studies and ground observations, such as the North Sand Dunes to North Platte River corridor and the Sheep Mountain to Independence Mountain corridor, our models revealed a larger corridor network. Many areas of high use within these corridors were identified as potential stopover areas. Most notably, the area extending from the North Sand Dunes to the North Platte River remains a heavily used area during both spring and fall migrations. In addition, Camp Creek, Owl Mountain State Wildlife Area, Delaney Butte, Sheep Mountain, Boettcher Ridge, Independence Mountain, and Pole Mountain appear to be areas utilized as stopover areas. Interestingly, all of these areas are classified as historic winter range (Figs 6 & 7).

CWD Management Implications

As of 2023, mandatory testing of harvested D3 mule deer revealed concerning findings regarding CWD prevalence. Currently, CWD prevalence in North Park is estimated at 15.3% (95% Confidence Interval [CI] 9.3% - 23.0%), surpassing the CPW management threshold of 5% (Colorado Parks and Wildlife 2018). This prevalence is a substantial increase from previous years, with estimates of 5.9% (95% CI 2.6% - 11.3%) in 2020 and 11.0% (95% CI 7.2% - 16.8%) in 2021.

Migratory patterns of D3 deer add complexity to local management efforts to reduce CWD prevalence rates. It's possible that the recent increase in CWD prevalence is a delayed consequence of years of low-level transmission among other herds. Anecdotal evidence from other deer herds in Colorado suggests that once CWD prevalence reaches 5%, transmission rates appear to accelerate, posing greater challenges for reducing prevalence. The recent spike in prevalence might indicate that this acceleration has occurred within a relatively short timeframe and underscores the urgency for both proactive and reactive management actions.

Comparative prevalence data from neighboring deer herds appear to corroborate the distribution of migrating deer in North Park. In D9 Middle Park, prevalence measured 6% in 2022, while in D4 Red Feather/Poudre River and D10 Big Thompson, prevalence rates were approximately 3.9% (2022) and 7.3% (2023), respectively. In the Platte Valley herd in Wyoming, where most D3 deer winter, a prevalence rate of 13.3% (95% CI 6.7% - 20.9%) was observed in 2023 (Teal Cufaude, Wyoming Game and Fish Department, pers. communication). The alignment of prevalence rates between D3 and the Platte Valley may affirm a strong connection between these deer herds. Historical data on CWD prevalence in the Platte Valley are limited, but if the disease has been present there for an extended period, it's plausible that migratory deer introduced it to North Park.

The escalating prevalence of CWD in D3 mule deer poses a significant management challenge. Since 2022, CPW has incrementally increased buck deer licenses as additional buck harvest has been demonstrated to reduce transmission rates (Conner et al. 2021). However, additional action in collaboration with neighboring regions, particularly with WGFD in the Platte Valley, may be required to address the interconnected nature of CWD transmission and appropriately align management approaches.

Risk of Vehicle Collisions

Our models revealed several areas where one or more migration pathways intersect roadways (Fig 10), thus highlighting areas where the risk of deer-vehicle collisions may be highest during fall and spring. We identified two of these crossing areas where higher-use corridors intersect discrete sections of highway, and may represent the greatest risk to migrating deer in D3. The intersection of U.S. Highway 40 and Colorado State Highway 14, located at Muddy Pass in the southwest corner of North Park, experiences high volumes of vehicle traffic year round. In addition to mule deer, anecdotal and empirical evidence also suggest relatively large numbers of pronghorn and elk also use this corridor. To the north, the section of Colorado State Highway 125 from Cowdrey north to the Wyoming state line, and Colorado State Highway 127 from its intersection with Highway 125 east approximately 4 miles lies a substantial juncture with a heavily utilized migration corridor. Nearly all deer migrating into Wyoming appear to cross one of these two northern highway segments. Although CPW does not currently observe large numbers of deer-vehicle collisions in these areas, or the other six identified at-grade road crossing areas, future changes in D3's deer population, migratory behaviors, or vehicle traffic volumes may present risks to wildlife and human safety.

Summary

After analyzing three and a half years of location data from mule deer in North Park, our study yielded valuable insights into seasonal deer behavior and movements in DAU D3. We confirmed that the majority of (if not all) D3 deer migrate out of North Park each year to winter range in neighboring regions. Given that over 80% of our study animals utilized winter range in Wyoming, it appears that deer from D3 and the Platte Valley are highly connected, and may biologically function as a single herd.

Our results support previous anecdotal claims of a significant shift in deer behavior over the last several decades, prior to which the majority of deer utilized winter range in North Park. Several factors may have contributed to this shift, with past management practices and harvest prescriptions potentially playing a key role. Despite this behavioral shift, D3 still maintains a modest deer population and is currently situated within CPW's population objective range of 4,500 – 6,500 animals. However, the transition to predominantly migratory behavior may have substantial implications, including additional harvest pressure, increased risks of disease transmission, and greater vehicle collision risk. CPW wildlife managers and biologists must acknowledge these implications and work cooperatively with neighboring regions to ensure the long-term health and sustainability of this deer herd.

ACKNOWLEDGEMENTS

This project was made possible through funding from U.S. DOI Secretarial Order 3362, which provided support to purchase GPS collars, capture supplies, and aerial capture services. We are also grateful for significant efforts made by CPW and WGFD staff assisting with many aspects of this project. CPW wildlife managers Zach Weaver, Jacob Way, and Josh Dilley, CPW terrestrial biologists Jeff Yost, Genevieve Fuller, Joe Halseth, Elissa Slezak, and Brad Banulis, CPW technicians Aspen Spiker, Ellen Peterson, Charlee Manguso, Gary Birch, Mikayla Bivona, and Cameron Morrison, and WGFD wildlife biologist Teal Cufaude all contributed their time and expertise with ground darting efforts, developing and maintaining relationships with private landowners, retrieving collars, and providing thoughtful discussion on mule deer migration and management in North Park and the Platte Valley. Without their involvement, this project would have never gotten off the ground. Thank you.



North Park buck in October along a known migration route to winter range in the Platte Valley, Wyoming. Photo Credit: JBWay Photography

APPENDIX 1: FIGURES REFERENCED FROM TEXT

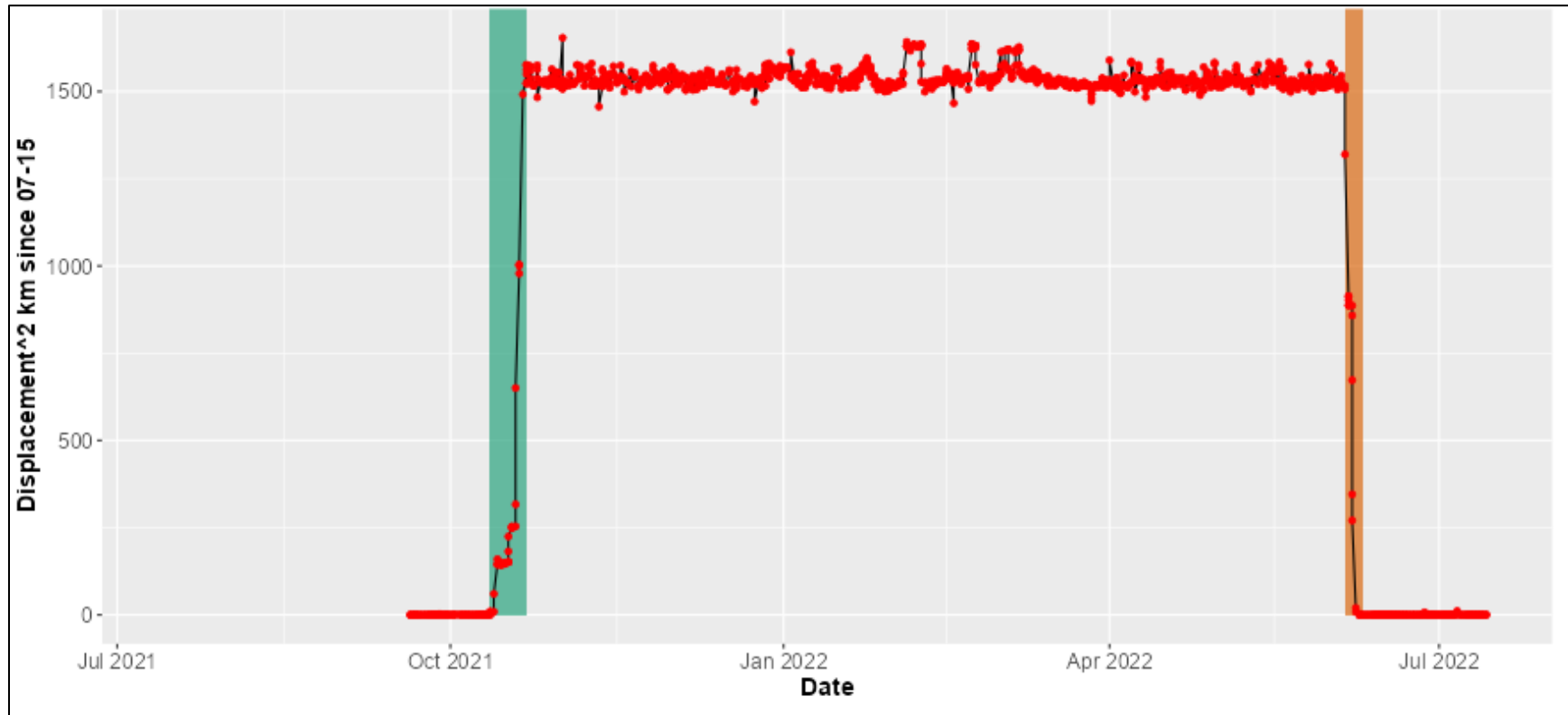


Figure 1. Net squared displacement plot of an individual mule deer. Red dots represent GPS locations through time and their relative displacement away from summer range (flattened baseline). Note the short period of time in late October where relative distance from summer range increases sharply (i.e. fall migration in green) and again in early June when departing winter range (i.e. spring migration in orange). The flattened peak on this plot represents a stable winter home range.

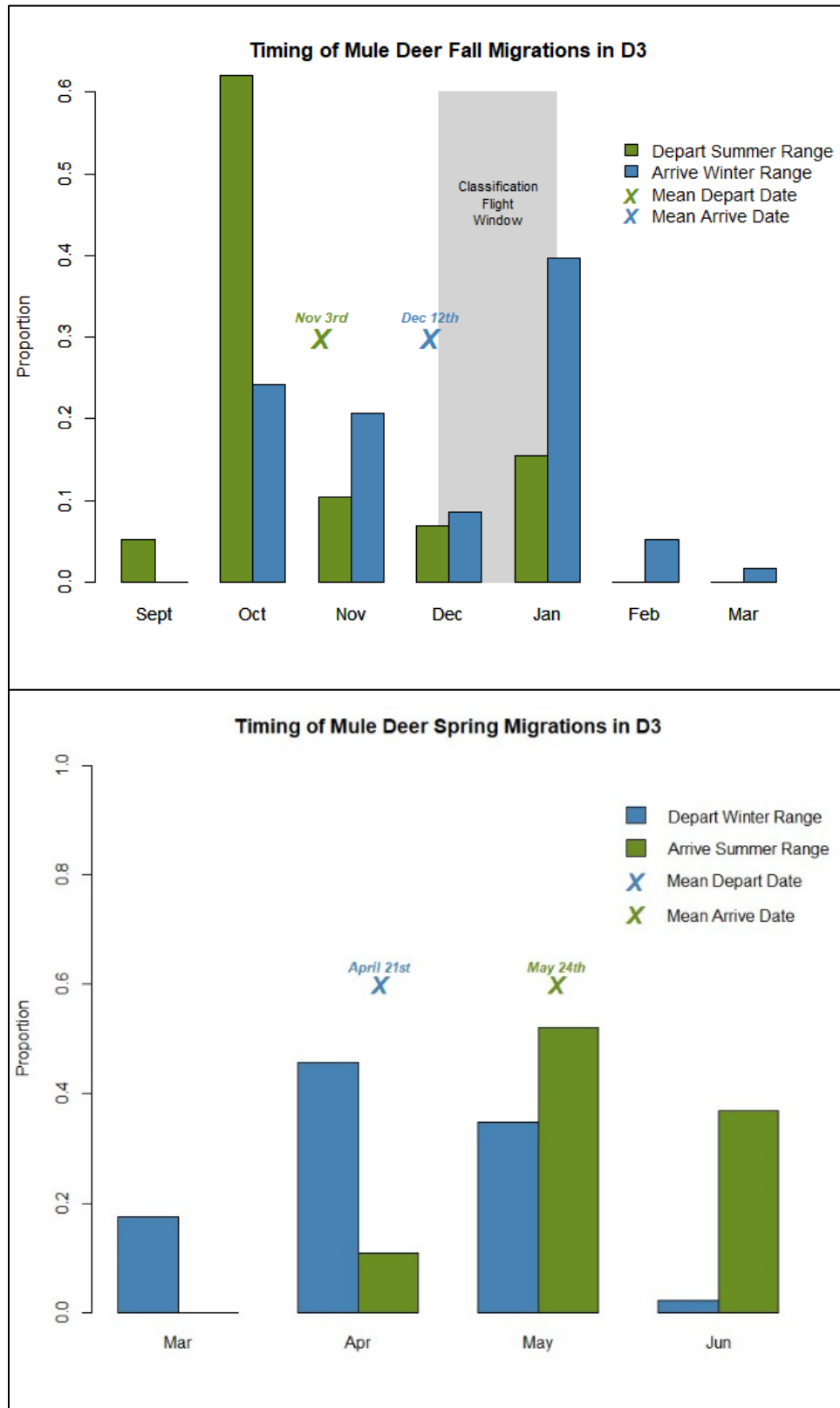


Figure 2. Histograms of the proportion of deer, by month, beginning and finishing fall and spring migration periods.

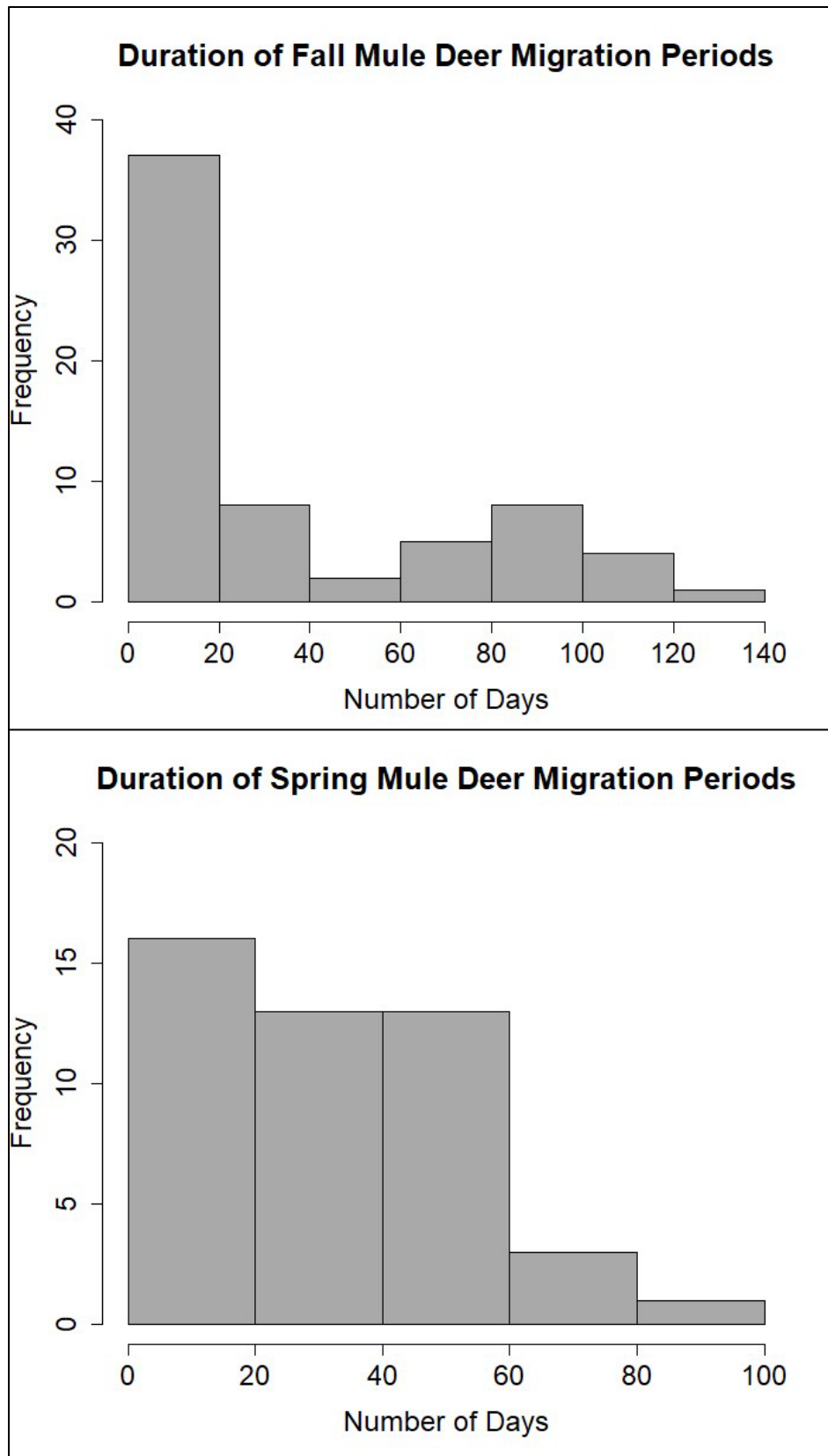


Figure 3. Histograms of the time spent migrating by individual mule deer during fall and spring migrations

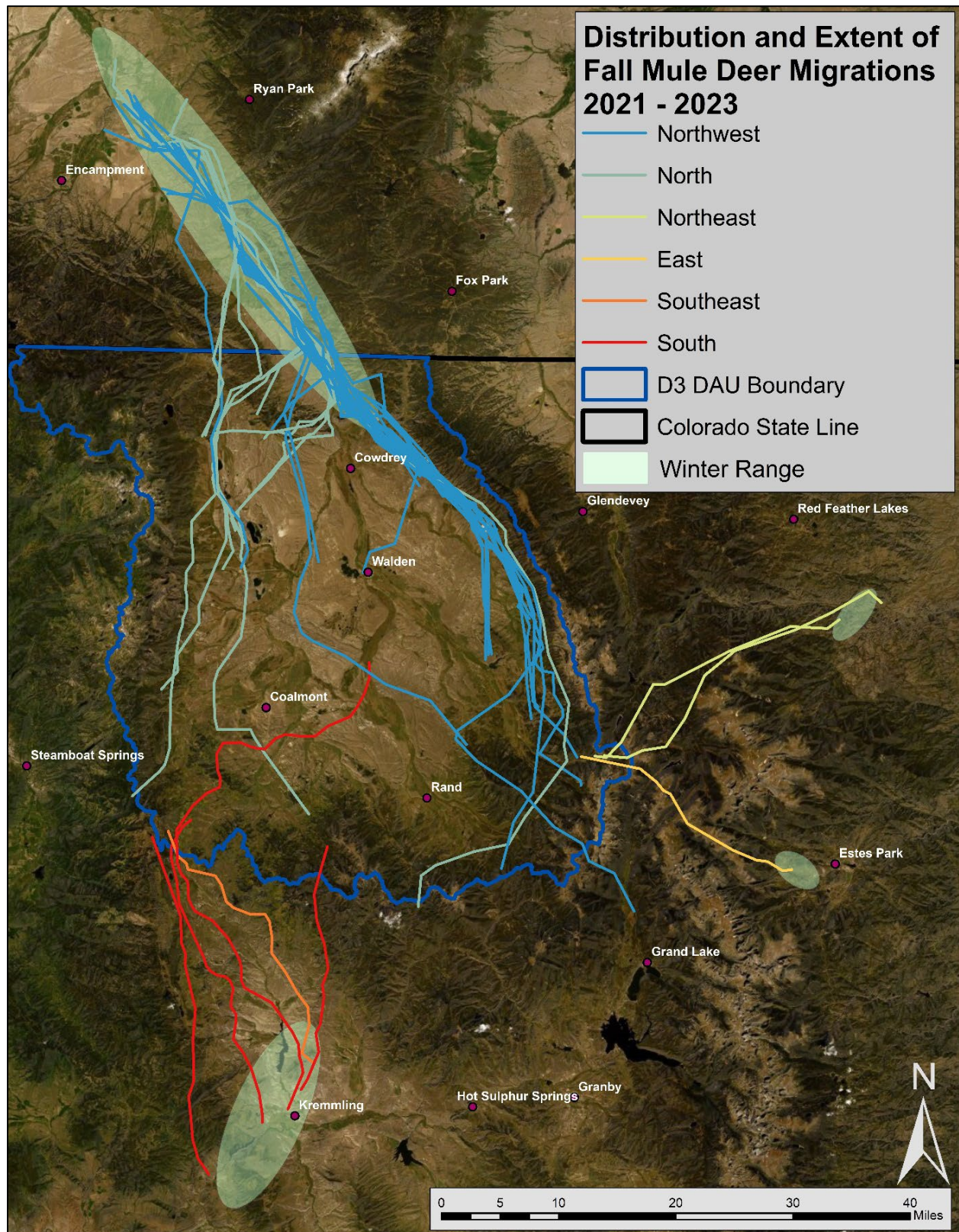


Figure 4. Approximate migration routes from mule deer on summer range in North Park traveling to adjacent winter ranges outside of the DAU. Line color depicts direction of travel.

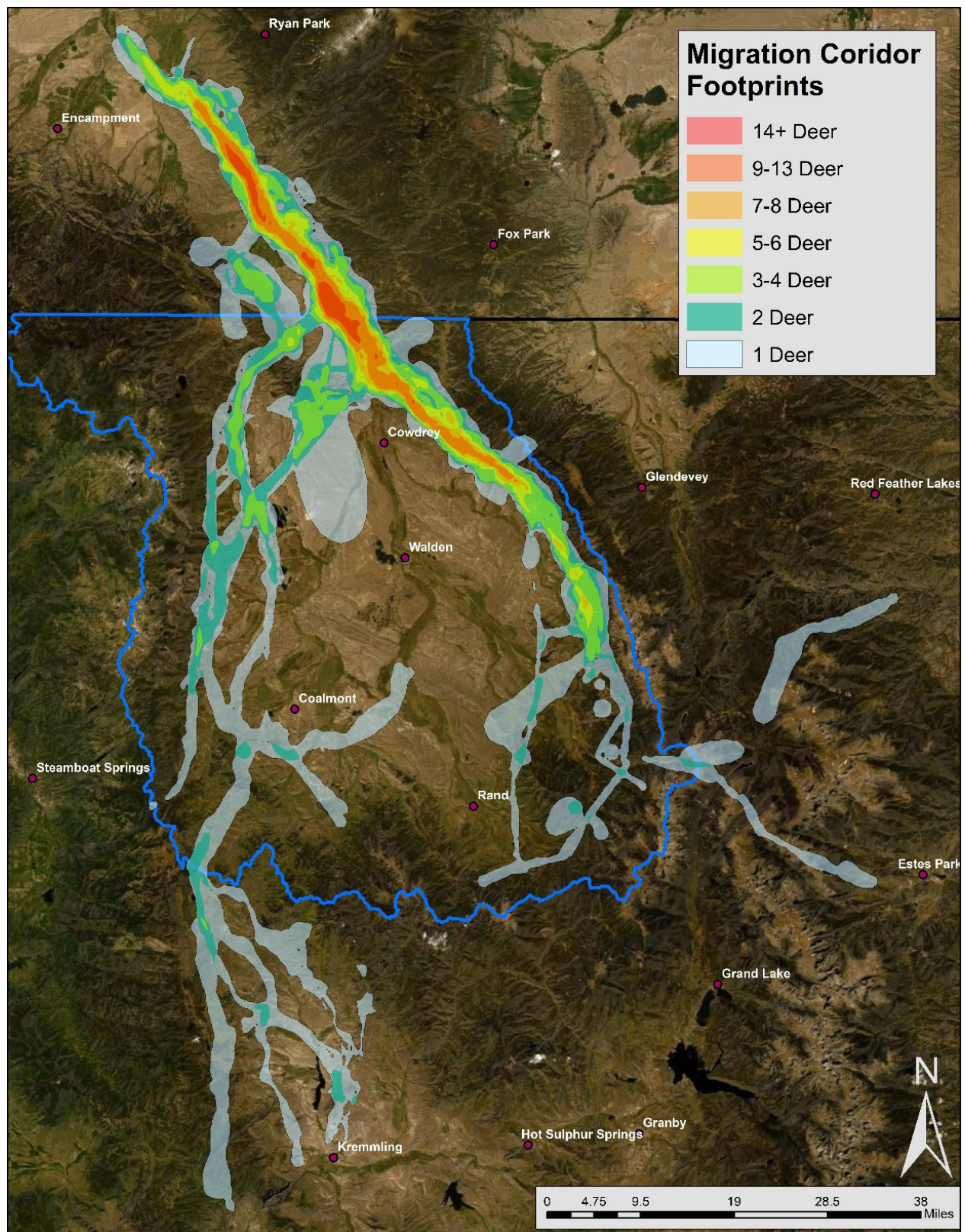


Figure 5. Dynamic Brownian Bridge movement model depicting all identifiable migration corridors (i.e. ≥ 1 deer) as well as high use corridors (i.e. >5 deer) from 104 unique fall and spring migration sequences.

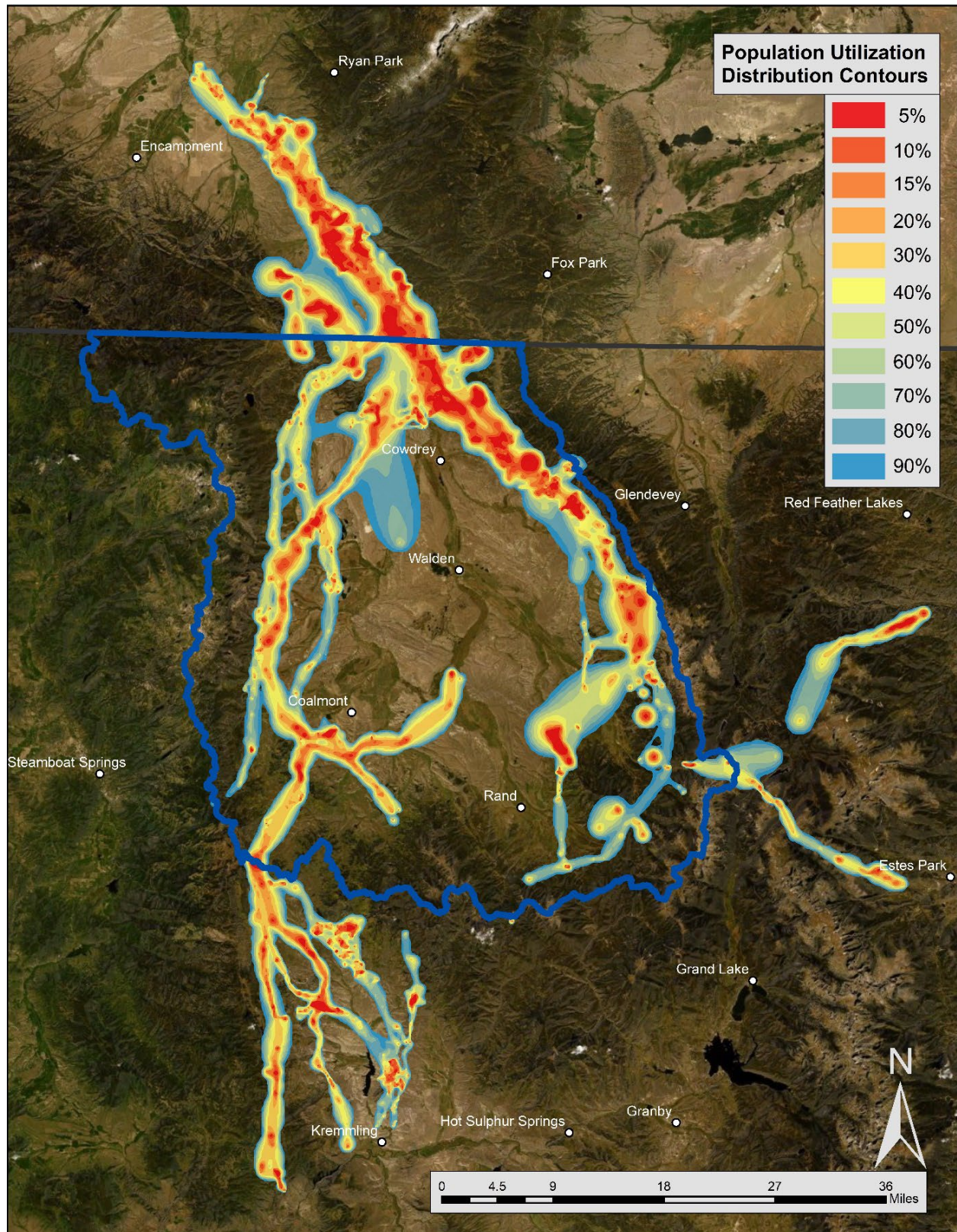


Figure 6. Population utilization distribution derived within the footprint of 104 unique migration sequences.

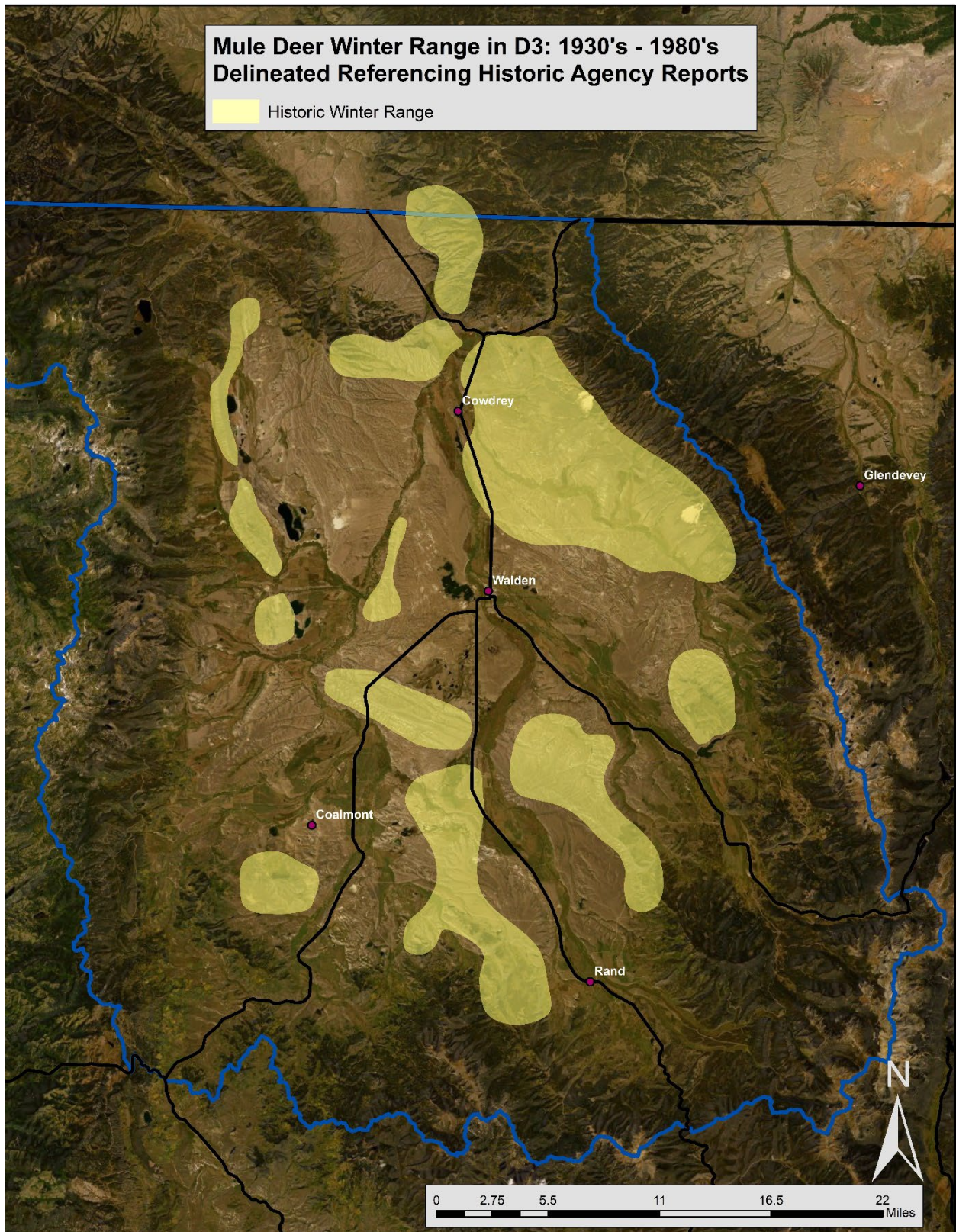


Figure 7. Historic mule deer winter range in D3. Very few, if any, deer utilize this winter range today. Instead, many of these areas are now used as stopover areas during spring and fall migrations.

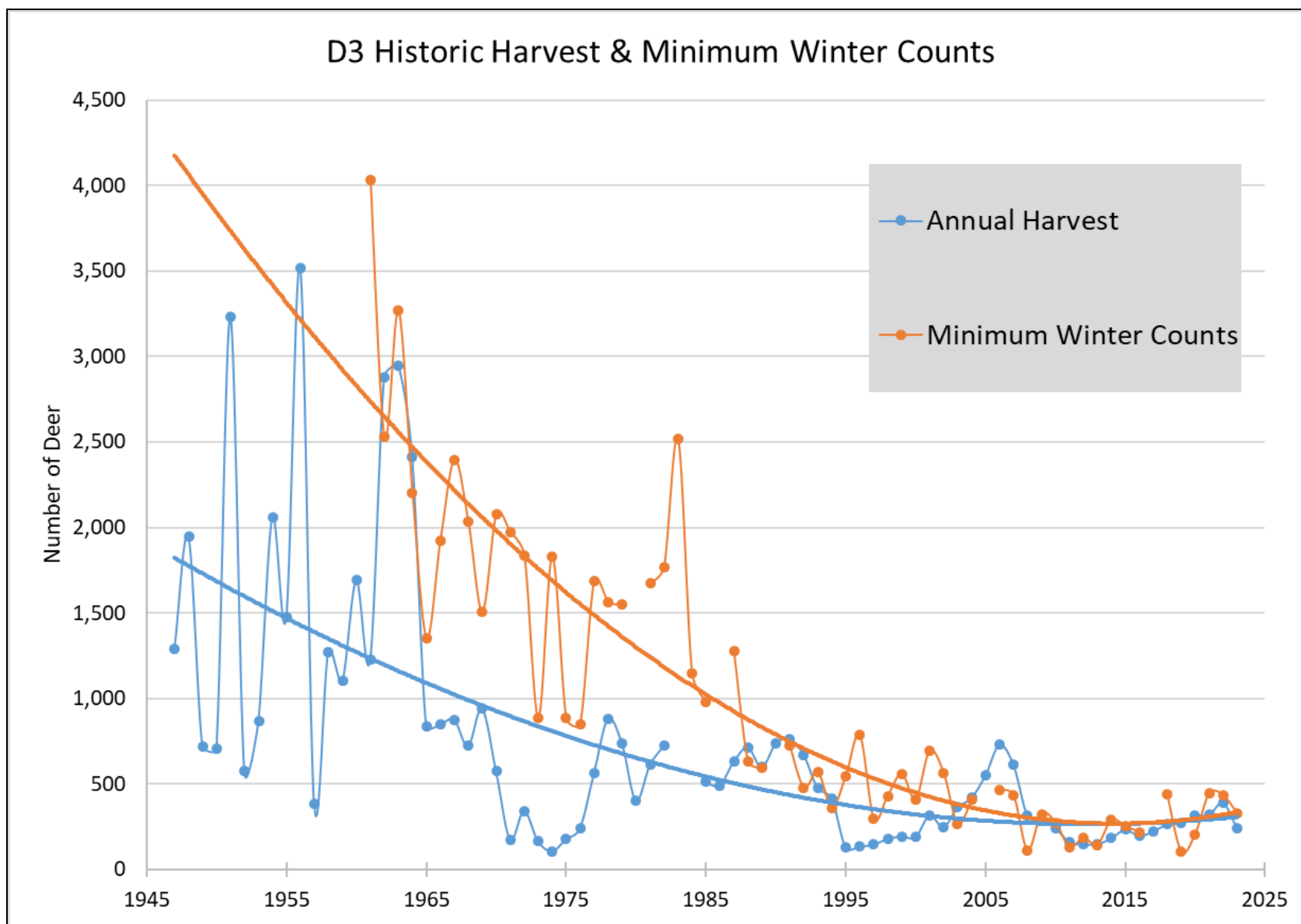


Figure 8. Historic harvest and minimum count trends in D3 from 1947 - 2023. Note minimum winter count data are unavailable prior to 1961.

| Year | License Type | # Deer Allowed to Harvest Per License | Approximate Timing of Hunts | Total Harvest | Minimum Winter Counts |
|------|---------------|---------------------------------------|-----------------------------|---------------|-----------------------|
| 1947 | Either-Sex | 1 | Oct | 1,289 | NA |
| 1948 | Either-Sex | 1 | Oct | 1,945 | NA |
| 1949 | Either-Sex | 1 | Oct | 721 | NA |
| 1950 | Antlered Only | 1 | Oct | 704 | NA |
| 1951 | Either-Sex | 2 | Oct - Nov | 3,229 | NA |
| 1952 | Either-Sex | 1 | Oct | 575 | NA |
| 1953 | Either-Sex | 1 | Oct - Nov | 865 | NA |
| 1954 | Either-Sex | 1 | Oct - Nov | 2,058 | NA |
| 1955 | Either-Sex | 3 | Oct - Nov | 1,478 | NA |
| 1956 | Either-Sex | 3 | Oct - Dec | 3,515 | NA |
| 1957 | Either-Sex | 3 | Oct - Dec | 386 | NA |
| 1958 | Either-Sex | 3 | Oct - Nov | 1,272 | NA |
| 1959 | Either-Sex | 3 | Oct - Nov | 1,101 | NA |
| 1960 | Either-Sex | 3 | Oct - Dec | 1,690 | NA |
| 1961 | Either-Sex | 3 | Oct - Dec | 1,230 | 4,034 |
| 1962 | Either-Sex | 3 | Oct - Dec | 2,878 | 2,530 |
| 1963 | Either-Sex | 3 | Oct - Dec | 2,946 | 3,269 |
| 1964 | Either-Sex | 3 | Oct - Nov | 2,415 | 2,202 |
| 1965 | Either-Sex | 3 | Oct - Nov | 839 | 1,354 |
| 1966 | Either-Sex | 1 | Oct | 848 | 1,925 |
| 1967 | Either-Sex | 1 | Oct - Nov | 876 | 2,396 |
| 1968 | Either-Sex | 1 | Oct - Nov | 722 | 2,032 |
| 1969 | Either-Sex | 1 | Oct - Nov | 940 | 1,506 |
| 1970 | Either-Sex | 1 | Oct | 574 | 2,078 |
| 1971 | Antlered Only | 1 | Oct - Nov | 175 | 1,973 |
| 1972 | Antlered Only | 1 | Oct | 343 | 1,836 |
| 1973 | Antlered Only | 1 | Oct | 166 | 884 |

Table 1. Harvest prescriptions, total deer harvested, and minimum winter count data from 1947 – 1973. Highlighted cells represent years of high harvest prescriptions



Figure 9. Looking west over the North Sand Dunes, 6 miles east of Cowdrey, Colorado. This area was historically one of the primary mule deer winter range areas in North Park, and still retains quality winter browse including big sage and bitterbrush. Today this area is generally regarded as both summer range and as a major stopover area during fall and spring migrations. Photo Credit: Jamie J. Brown Photography.

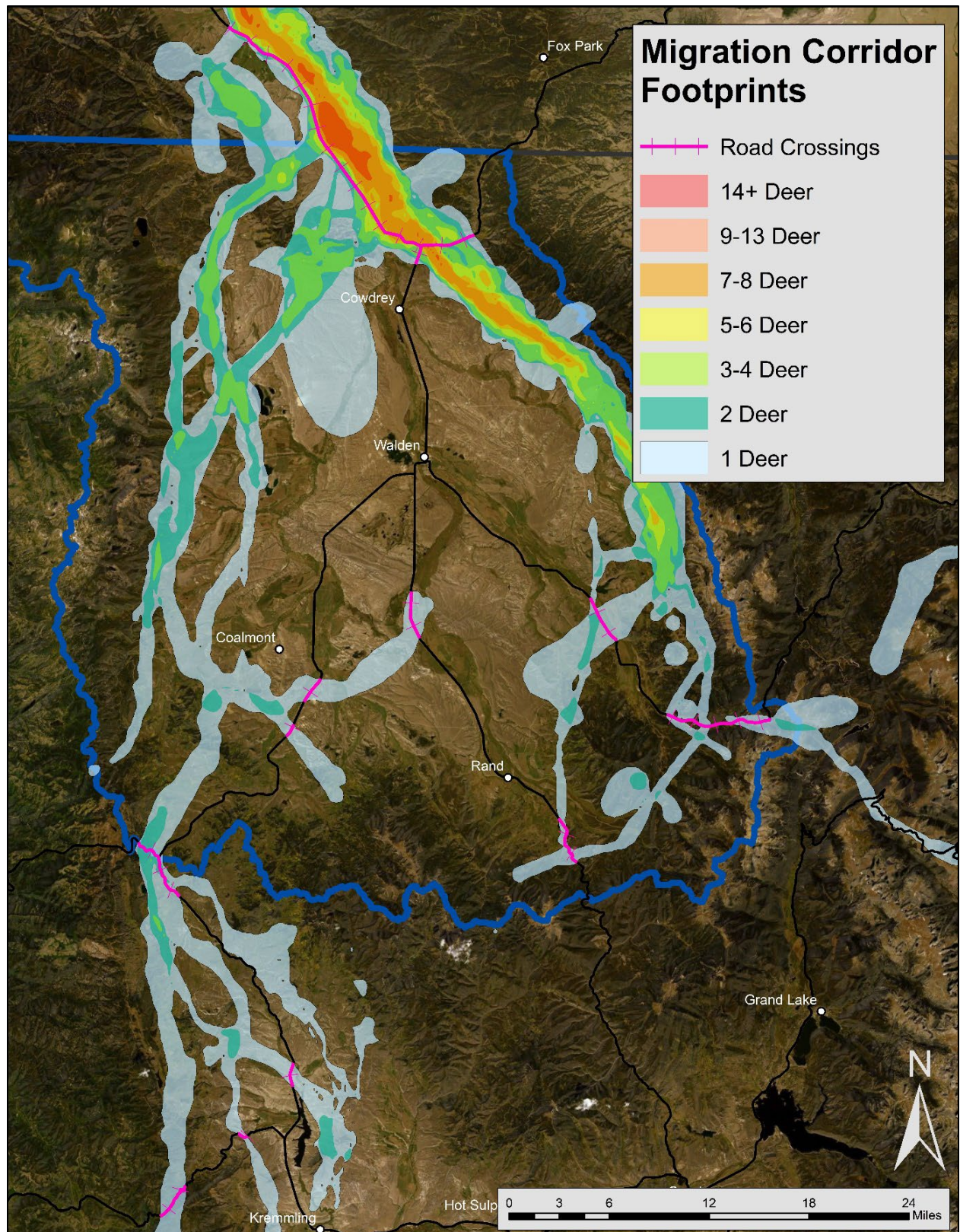


Figure 10. Migration corridor footprints intersecting paved highways. Discrete road segments highlighted in pink represent areas where our dBMM indicates ≥ 1 deer crossed a paved highway during migration.

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